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TIME is a hard thing to comprehend. So we divide it up into years and months and days and hours and minutes and seconds. This doesn't measure it very accurately for some of us, but it does give us something to measure from. With this number we start volume number thirty-seven. No, we haven't formed any new resolutions. The year past has been a good year—we have done some things we are proud of; we have done some things which could have been done better. We have thought over the old year, but it is behind us now and we have forgotten it. We do know that we have before us a whole new year with which we can do what we will. It is not natural for men to say or think, "I don't want to do as well next time." All the average man wants is a new starting place—a chance to try again. His instinct is to do better the next time. So we haven't made any resolutions. But we are glad that a new year means a chance to wipe off the slate and start over again.

STEAM RAILWAY ELECTRIFICATION.

During the year 1913 many steam railway mechanical officers will be called upon to render opinions on the feasibility of certain electrification projects. On large systems these electrifications will concern only zones which for many reasons can be operated electrically with better general satisfaction than by steam power. In such cases the voice of the public often has the greatest weight. It is, nevertheless, essential that those in authority may know positively what the comparative operating costs will be, and that they have a good general knowledge of the situation, which is a constantly changing one. On small systems the coming electrifications will be attacked from a different standpoint. Those in charge will not find it necessary to haul heavy through passenger or freight trains by means of power applied through locomotives, but will be concerned only with the problem of changing all equipment to the conventional interurban type.

The first class of problem concerns the mechanical officer, to the greatest extent. It has often been stated that the method of electrical zone operation of today is obsolete tomorrow. In answer to this argument the electrical engineer points out the fact that there is now smaller chance of fundamental improvement in the design of electric locomotives than there is in that of steam locomotives. The methods of comparison by which this conclusion is reached are, however, in dispute. The steam locomotive is considered as a whole, including the steam-generating outfit, as well as the means of power application; while an efficiency of as high as 92 per cent from third rail to driven rim is credited to the electric locomotive considered only as a means of power application. This may lead to error on the part of those who have not made a careful study of transmission and power plant generation. Owing to certain limitations of coal-burning capacity in steam locomotives, it is undoubtedly possible to obtain greater "service capacity" from electric operation. The steam locomotive must sacrifice speed for draw-bar pull when the capacity of the boiler is exceeded. The latter at present is limited, in coal-burning territory, by the amount of coal which can be fired by one man. The electric locomotives, designed for heavy hauling at thirty

miles per hour on level tracks, can, it is claimed, maintain a much higher speed on ruling grades than can the steam locomotive designed for like service. This gives a greater so-called "service capacity," which is the product of tonnage and speed.

In comparing results to be expected from the two systems of operation, it seems a regretable fact that those who favor electricity are wont to charge too much operating expense to steam. For instance, estimates on electrification are sometimes based on the lengthening of locomotive divisions to double the present lengths. This will probably be found unwarranted for other reasons than those considered. Other comparative estimates include fuel costs, due to waste in steam operation, out of proportion to the facts. One engineer allows one thousand pounds of coal per engine for firing up, one thousand pounds per hour per engine wasted while standing, nine hundred and fifty pounds per hour for coasting and one hundred and fifty pounds per hour used in banked fires while the engine is housed.

Disappointment cannot but result from decisions based upon figures which are not carefully based upon facts, and the argument in favor of desirable zone electrifications do not need anything more than the most fair comparison for substantiation.

RAILWAY CLUBS FOR RAILWAY MEN.

The railway club is primarily for the railway man. Others may do much in contributing toward its success—by their attendance, by their financial support and by giving members the benefit of their knowledge. There are many men not actively engaged in railway work who have much of interest to say to the man who is; who can enlighten him on points in the manufacture and operation of equipment and who can promote closer harmony between the man who makes and the man who uses.

But the railway club is for the railway man, and the club which does not recognize this fact will not flourish. Railway men should deliver a large percentage of the papers, and railway men should lead in the discussions. It is up to the officer to see that the most competent men available are procured to deliver papers and that certain men known to be interested in a certain subject are asked to be present and contribute toward that discussion. There are certainly enough live questions before the railway world today, and it is still more certain that there are plenty of good live railway men who can discuss them. If the officers go after them there should be no lack of good available speakers. A poorly delivered paper, or a paper on an uninteresting subject at a meeting does much more harm to a club than a poor attendance on account of weather conditions, for the members who attend feel that they have exerted themselves to add to their store of usefulness and knowledge and have come away empty handed.

Railway men when they go to their club meetings, aside from the fellowship of meeting others, go because they want to hear what one of their own number has to say; they want to hear what he is up against, to tell him how they got around it and the difficulties they had. That is what makes the railway club of the most value not only to the railroad man, but to every one concerned.

ROD TRANSMISSION OF POWER IN ELECTRIC LOCOMOTIVES.

The attempted adaptation of certain principles of steam locomotive construction to modern electric locomotives has been unsuccessful in several instances. This seems to be partially true with reference to rod transmission of power from the motors to the driving wheels and to the coupling of the latter. The internal resistances of these locomotives have been found very high and an increase in the number of coupled axles, of course, serves to increase these resistances very materially. In answer to a demand for electric locomotives with large motors and a high center of gravity several designs have included rod coupling of drivers and rod transmission from motor to jack shaft and to main drivers.

It is admitted pretty generally that the service results from the locomotives built according to these designs have been somewhat disappointing. Some attribute this to the alleged fact that the designs in question were based upon false assumptions. It is asserted that the easy riding qualities of certain locomotives are not due to their high centers of gravity but depend upon the relation of the height of gravity to the width of the spring base. That is: practically the same changes in riding qualities may be obtained by varying the width of the spring base as by increasing the height of the center of gravity.

Rod transmission lends itself readily to the type of locomotives with the axle bearings inside the frames and an article on this subject published on another page of this issue serves to throw some light upon the situation. The author shows how unavoidable variations in journals, diameters of wheels and the like all operate to increase the resistance of rod transmission. A careful study of his formulae should be of material assistance in the designing of electric power units.

SAFETY FIRST rallies are increasing in popularity. Following the Kansas City rally of last October, a safety rally was held at Buffalo, N. Y., on the evening of December 17 which was participated in by railroad employees conveniently situated to that city. Addresses were given by J. G. Rodgers, general superintendent, Pennsylvania; P. E. Crowley, general manager, N. Y. C. & H. R.; T. E. Clarke, assistant to the president, D. L. & W., and C. L. Bardoo, assistant to general manager, Lehigh Valley. D. R. MacBain, superintendent of motive power of the L. S. & M. S., was slated to give a talk, but was unable to be present. Short talks were given by a number of engine men and conductors, and an illustrated lecture by George Bradshaw, general safety agent of the New York Central Lines. Music was furnished by the Lehigh Valley shop band.

Don't let the worry habit ball everything up; flag it.

* * *

Many an engineer watching the steam-gauge on the engine forgets to look at his own indicator. He may be nearing the pressure limit without realizing it.

* * *

When your system gets chock full of ugliness, throw a derail under it, call a wrecker and put it on the rip track.

* * *

Don't let a grouch block your right-of-way to happiness.

* * *

If the other fellow has the right-of-way over you because of his efficiency, don't be a sorehead. Study efficiency yourself and win.

LOCOMOTIVE FUEL CONSUMPTION.

Editor, Railway Master Mechanic: I have noted the letter of J. G. Van Zandt in your December issue, referring to my article on "Locomotive Fuel Consumption," also to a constant formula for resistance as adopted by the American Railway Engineering Association.

As chairman of "the committee which influenced the adoption" of that formula, I desire to state that the conclusions as adopted and shown in the Manual of 1911 with reference to resistance were based on results obtained from a large number of dynamometer tests on different railroads, each of the tests covering as much or more data than that shown in Bulletin 43 of the Illinois Engineering Experiment Station. The tests and analyses of the records were made by men as familiar with the processes of analyzing the same as were those who made the Schmidt tests.

No criticism of Prof. Schmidt's analyses of the tests on this particular division is intended, and I am not surprised at the results which he obtained. The Chicago division on which his tests were made is an extremely busy double track road with a number of heavy and fast passenger trains daily.

An engineer dislikes to publicly criticize track conditions on any road, as most of us realize that we have "glass houses" on our own lines. However, the bulk of Prof. Schmidt's tests were made in the spring months, at a time when track is in its worst condition, and when there had not sufficient time elapsed to place it in even a fair average condition.

Furthermore, it is questionable whether a force of one man per mile of track on a road laid with angle bars, and with busy traffic, can maintain this track in a good condition of line and surface. We know of similar divisions of heavier rail and modern rail joints averaging over 50 per cent higher force.

To those who traveled over this track at about the time of Prof. Schmidt's tests, the fact was evident that the joints were far from being in good condition, and the Illinois Central has since recognized this point and is using an improved type of joint much stiffer than the angle bar. Any imperfections of line and surface will have a tendency to produce higher draw bar pulls at the increased speeds, and in some details the maintenance of equipment may produce this effect, but in track with sufficiently stiff rail and joints, and maintained in condition for passenger traffic, no practical increase in freight train resistance is noted within the limits of ten to thirty-five miles per hour.

Messrs. Dennis and Begien, as well as the undersigned, were originally of the same opinion as Mr. Van Zandt, but were forced by the weight of the evidence to acknowledge that the resistance would be practically a constant within the ordinary limits of freight train speed on properly maintained track. Mr. D. E. Crawford called attention to this point several years ago, after extensive tests on the Pennsylvania Lines.

In the following statement some facts are shown as deduced from dynamometer tests analyzed personally by the writer. These particular tests were on a valley division of long tangents and long continuous stretches of exceedingly low gradient.

In analyzing tests on many other districts and platting the same graphically, a wide variation was noted in resistance for the same train for given velocities, but it appeared that a straight line representing uniform resistance would practically strike through the average of all these points, contrary to expectations.

The following tests were made particularly to determine the truth with reference to resistance at the higher velocities, and points were chosen to eliminate the question of acceleration and gradient as far as possible. The track was well ballasted to grade stakes within two years' prior to the test and had been maintained in good condition.

According to Prof. Schmidt's formula the draw bar pull on level grade test "B" could have been 9,004 lbs. at 30.5 M P H for this locomotive and on descending .0517% grade test "A" 8,384 lbs. at 35 M P H.

No fireman could put coal enough into the fire box of this locomotive to develop this power at the given speeds. This train was sent over the entire division, and the *average* of all points and velocities did not vary far from those given above after the journals had been warmed up, although individual points varied considerably from the average.

With such facts as these in the hands of a man who has been in practical work and study of these questions for a number of years, it is impossible to accept the view that the Schmidt tests should always be applied in making economic studies, but they can be used in considering economic value of good track maintenance.

Problems of Economics of Location must be based on the assumption that the type of materials used and the labor expended in maintenance have been such as to produce the most economical results.

Since the report to the American Railway Engineering Association, the Baltimore & Ohio has been to a large expense in making some extensive dynamometer tests and having the same analyzed by a specially organized force for the work. From these tests nothing has developed to show that the American Railway Engineering Association should reconsider its constant formula.

It would be well for the Engineering Fraternity to recognize that estimating of train resistance can never be reduced to an exact science. The variables are too complex to make this possible. It should be unnecessary to go into detail to explain why this is so, as pages have been written on the subject.

To those who know the men, it appears foolish to think that Mr. D. E. Crawford, general superintendent motive power, Penna. Lines West, Mr. A. C. Dennis or Mr. R. N. Begien would support a constant resistance formula for a given weight car where their original inclination was to believe otherwise, except that the mass of evidence conclusively proved the fact.

(Signed) A. K. SHURTLEFF.

Details of a Typical Test.

Locomotive.

Type 4-6-0.
Cylinders 19x24 in.
Drivers 69 in.
Boiler pressure, 180 lbs.
Heating surface 1,800 sq. ft.
Weight on drivers 131,200 lbs.
Total weight working order, including tender, 238,400 lbs.

	A	B	C
No. cars in train	34	34	39
Scale weight of train	1,354 tons	1,354 tons	1,584 tons
Average weight per car	39.8 tons	39.8 tons	40.6 tons
Distance maintained speed	4,625 feet	4,475 feet	4,700 feet
Time in passing distance	90 seconds	100 seconds	120 seconds
Velocity in passing distance	35 M P H	30.5 M P H	26.7 M P H
Uniform gradient	—.0517%	Level	—.034%
Recorded draw bar pull	5,000 lbs.	6,500 lbs.	6,500 lbs.
Recorded draw bar pull per ton of train	3.69 lbs.	4.80 lbs.	4.10 lbs.
"R" per ton corrected for level grade	4.72 lbs.	4.80 lbs.	4.78 lbs.
"R" as per Schmidt formula	7.23	6.65	6.21

Missouri Pacific Shops at Hoisington, Kan,

As the shops of the Missouri Pacific at Hoisington, Kansas, had become antiquated and inadequate for the present needs of the road at that point, it was decided in the spring of 1910 to demolish the old buildings and erect new ones upon a nearby site which would afford better yard facilities.

In order to make the property selected for the location suitable it was found necessary to divert the course of a small stream, which was accomplished by means of a channel change. Furthermore, on account of the difference in elevation between the new site and the surrounding property it was necessary to make a five-foot fill. The improvements included the erection of a machine and erecting shop with transfer table, blacksmith shop, roundhouse, with turntable, power house, oil house, fuel oil storage house, cinder pit, coaling station, concrete water reservoirs including battery of 4 deep well pumps, a 200,000-gal. elevated tank, the conversion of the old machine shop into a temporary planing mill and the erection of a temporary office building. In addition to the above improvements a boiler shop, planing mill and office and store room buildings are contemplated.

The machine and erecting shop which has 10 pits, is 223 feet long and 135 feet wide with one wing 30 feet by 88 feet for a tool room. It is a steel frame building with brick walls and concrete foundation. The brick walls run to the height of the crane girder, the space above being given to windows, and above that it is practically all window space between the columns. The walls supporting the space are of hollow tile block plastered with cement. All window sills and trim are of concrete. The foundation consists of a series of concrete piers with reinforced concrete girders between the piers.

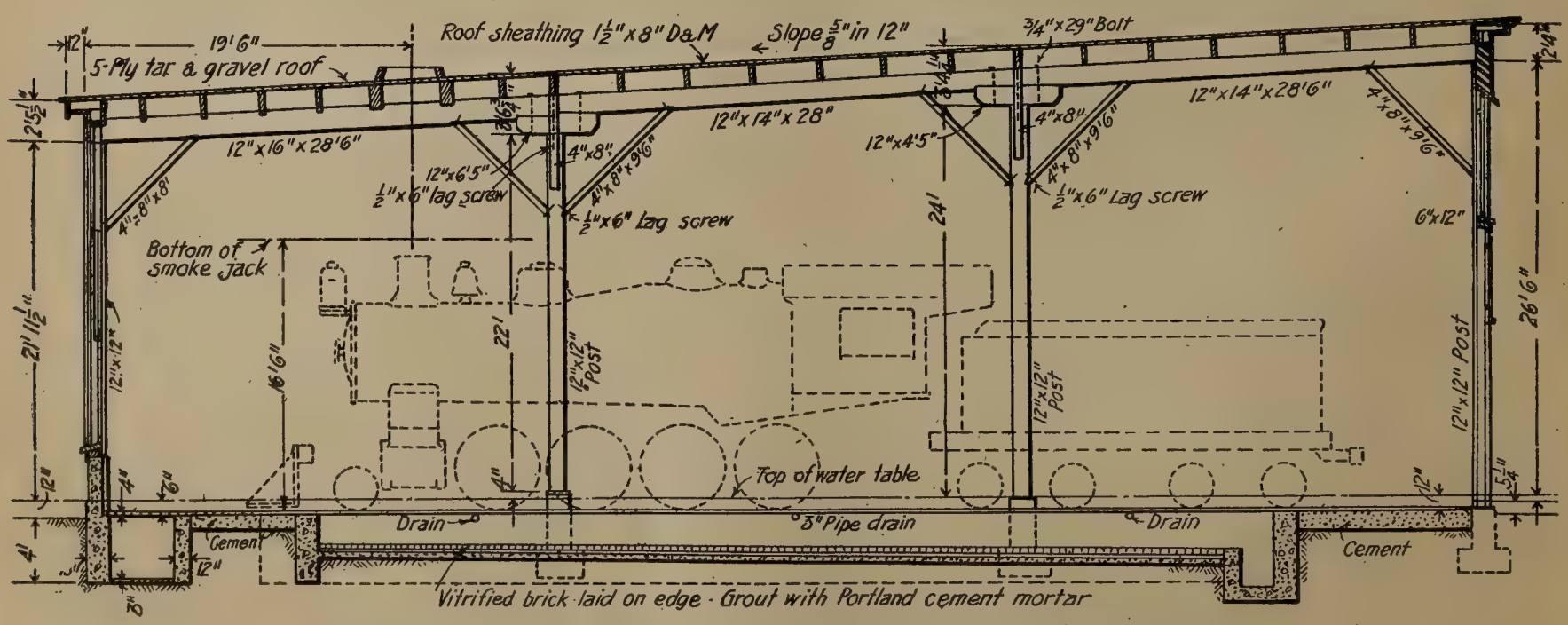
The floor is constructed of two thicknesses of 2x8 yellow pine laid on 4x6 sleepers embedded in cinders. The under floor is laid diagonally and the upper floor longitudinally of the shop. The large tools are provided with concrete foundations and the small tools are mounted on the floor.

The shop is heated by an indirect low pressure steam system with overhead ducts carried on roof trusses. The lighting facilities consist of regenerating flaming arcs for the general illumination and incandescent lights for detail lighting over the tools.

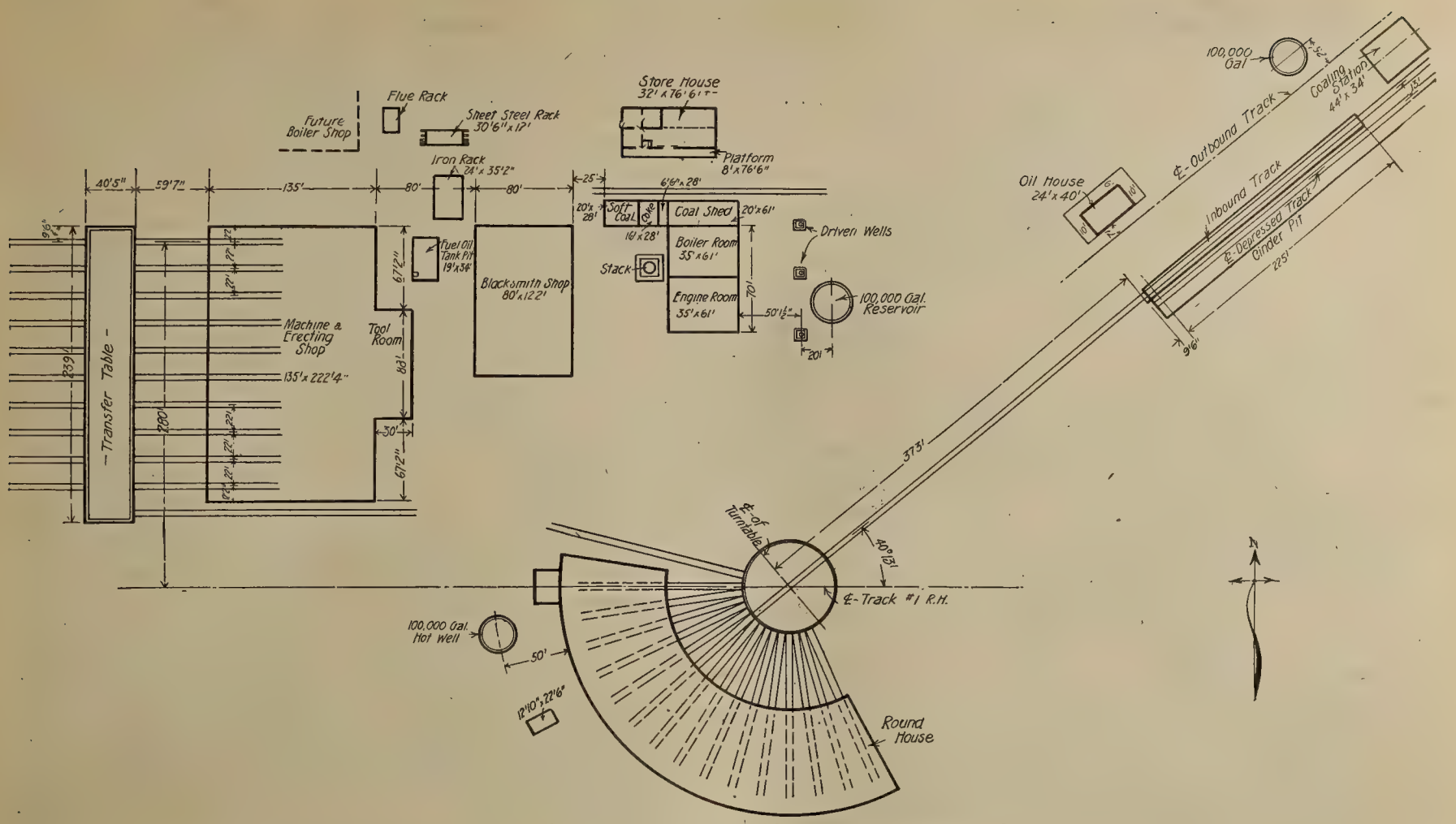
A 40-ft. electrically operated transfer table with capacity for handling 150 ton locomotives has been installed.

The machine tool equipment is of modern design. The large

General View of New Missouri Pacific Shops at Hoisington, Kan.



Section of Standard Missouri Pacific Roundhouse at Hoisington, Kan.



Layout of the Missouri Pacific Shops at Hoisington, Kan.

tools are individual motor driven and the small tools are group driven.

The blacksmith shop is a building 122 ft. long and 80 ft. wide. It has steel roof trusses supported by brick walls placed on a concrete foundation. The roof is of wood covered with Barrett specification roof and has a wide monitor. The shop has a cinder floor. The building is lighted with flaming arcs and heated with pipe coils. A steam hammer, jib cranes and the usual equipment of blacksmith tools have been installed. There are 10 forges in this building and a cast iron pipe blower system for the forges is located under the floor. Storage, steel sheet, iron and flue racks were built adjacent to this shop.

The roundhouse has 15½ stalls with an allowance for extension to the full circle of 44 stalls. It is a standard Missouri Pacific roundhouse with foundations of concrete piers with reinforced concrete girders. It is of wooden construction above foundation and is equipped with asbestos smoke jacks. The heating is accomplished by means of an indirect heating system with ducts under the floor. A 40-ft. turnfor handling 150-ton locomotives has been installed.

The services in this building consist of high pressure steam and air system and a 4-in. hot water supply as well as a raw and treated water supply. Connections are made at each pit for a blow off to boiler washing heating systems. In connection with the boiler washing system a 100,000-gal. hot water reservoir of reinforced concrete was constructed.

The power house is 70 ft. x 61 ft. with brick walls on concrete foundations. The boiler room equipment consists of 3 346 H. P. boilers connected through a steel flue to a 7 ft.

Roundhouse and Power House, Hoisington Shops.

Machine Bay of Erecting Shop, Missouri Pacific Ry., Hoisington, Kan.

x 150 ft. tile and reinforced concrete stack. The pump room at the basement floor level is provided with two 14x8x12 general service pumps, one 1,000 gal. fire pump, two boiler feed pumps and a drip return tank. A 1,000 H. P. feed water tank has been installed. The coal bunker is on the outside and is served by an overhead trestle. The engine room equipment consists of two compound engines direct connected to one 100 K. W. and one 200 K. W. three-wire generating units. An oil storage and a filtering and distributing system is also included.

The oil house is a concrete and brick building with basement. A platform extends around the three sides of the building. The floor and roof are of concrete. The cinder pit is of the standard Missouri Pacific design.

In the oil storage building fuel oil for the blacksmith shop fires is stored in iron tanks located in a concrete pit. The oil is pumped into the shops.

A general sewer system constructed of tile pipe connects all buildings and discharges into the creek nearby. General water supply and fire protection systems have been installed, the supply being furnished by a battery of four deep well pumps discharging into two reinforced concrete reservoirs. These systems take water from the reservoirs and discharge from pumps in the power house into a cast iron distributing system around the yard with connections to all buildings.

In addition to the raw water supply, a treated water supply is furnished from a treating plant located about a half mile west of the shops. The boilers in the power house, the roundhouse and the 100,000-gal. elevated tank located near the coaling station are all supplied from treated water system.

The electrical overhead distribution is on cedar poles set in concrete. In addition to supplying light and power to the shop buildings it carries the yard lighting system of regenerating flaming arcs.

High and low pressure steam and compressed air are distributed to all buildings by overhead systems either carried on trusses between buildings, or where the distances are too great, on an iron pole line with suspension cable.

The construction of these shops was carried out under the direction of the engineering and mechanical departments of the Missouri Pacific, and was designed and executed in its entirety by Westinghouse, Church, Kerr & Co., 10 Bridge St., New York.

A SUPERINTENDENT on the New York Central in going through an important yard on his division, saw the coupling lever of a car lying between the tracks. He said to a group of employes, "Get out your watches and see how long it takes me to throw this aside where it won't cause one of you yardmen to fall under a moving train." It took him less than ten seconds to walk to the lever, throw it aside and return. Even the ten seconds could have and should have been saved by the man who put it there, by throwing it aside in the first place. Now, if the superintendent of a large and busy division, who is responsible for the work of hundreds of men, can afford to think about and attend to these matters, do you think there is any excuse for saying that you haven't time to pay attention to such details?"—*From a booklet of the Safety Department of the New York Central.*

The man who tries to shirk responsibility is fooling himself as badly as the engineer who puts his handkerchief over the headlight to keep the engine from seeing the hills.

MECHANICAL DEPARTMENT WORK AT PANAMA.

The following is an extract of the important points in the annual report of A. L. Robinson, superintendent of the mechanical division, department of construction and engineering, dated August 1, 1912. It sets forth a number of interesting instances in which the government handles its work:

Throughout this year the mechanical division has operated under practically the same organization as that maintained during the former year, but with a slightly increased force and personnel, due to increased work.

The policy of concentrating manufacturing work and repairs to rolling equipment in Gorgona shops has been continued. The forces in outlying or district shops have been limited to only that number of men necessary to carry on the actual running and field repairs to equipment operating in each district, these shops having the privilege of calling upon the central (Gorgona) shop for temporary additional forces whenever the exigencies of their work make it more advisable to send out men than to bring in the equipment.

The concentration of all classes of mechanical work in Gorgona has resulted in this shop being operated up to its maximum capacity for eight hours during each working day and to about one-third of its capacity during a second shift of eight hours. The employment of two shifts enables this shop to work 16 hours out of each 24 upon all rush and short-time delivery orders without the employment of any overtime, at one and one-half times the usual rate of pay. In addition, the operation of any shop up to its maximum capacity produces more efficient results than where the fluctuation of work necessitates the reduction or increase of forces.

The concentration of work in Gorgona shops during the past year has resulted in this shop handling a monthly average of work as follows:

Heavy or general repairs to locomotives.....	17
Repairs to all classes of cars.....	1,500
Repairs to equipment other than locomotives and cars	204

And, in addition, some 930 shop and casting orders for the repairing of stationary equipment, manufacture of repair parts, and new material.

With the construction work drawing to a close, the general policy has been to gradually reduce the amount of repair parts and other material carried in storehouses, which policy required the mechanical division to handle more and more manufacturing work on short notice. It is estimated that one-third of the manufacturing orders require completion and delivery in from 3 to 10 days after order has been placed.

The handling of over 900 shop orders per month, with one-third of same on short delivery, and the large number of men placed under each foreman, necessitated said foremen being relieved of the detailed duties of deciding upon and procuring the proper material to be used in the manufacture of shop orders.

The planning department, inaugurated during the previous year, was, during the past year, enlarged upon and perfected to meet the requirements of the present work. All shop orders, after being approved by the superintendent, are sent first to this planning department, where drawings (if originated by division engineers) are checked. If no drawings accompany orders, sketches or necessary prints are prepared for shop use. A detailed bill of all necessary material for the completion of order is then prepared and taken to storehouse to ascertain whether such material is in stock. If all required material is not available, arrangements are made for substitutions. All material is then reserved in storehouse for each individual order. Storehouse requisitions, bill of material, drawings, and order are then forwarded to the shop.

This system has proved a very valuable adjunct; in fact, an absolute necessity, to the prompt and efficient handling of the large amount of emergency work being manufactured by this division. With it the foreman is relieved of the necessity for any checking of drawings, the ascertaining of whether material is in stock for the full completion of order, and the writing of storehouse requisitions. He takes up each manufacturing order with the full knowledge that there will be no delay in the procurement of his material, and can consequently devote his entire time to increasing the efficiency of the men under him.

Every order originating in construction divisions has a requested date of delivery on same. When these orders leave planning department and are sent to shops, copies are distributed to the foremen interested and work is immediately begun upon same. A meeting of all foremen is held in the general foreman's office each day at 1:30 p. m. for the checking of all orders overdue and all new orders which have been sent to the shops during the previous day. Each order is taken up by its number and each foreman having any work to perform upon same is called upon to give an estimate of the length of time which order will require in his department. For example, when an order originates in foundry, foundry foreman states the number of days he will require for completion of rough castings; machine shop foreman states length of time he will require for machining of castings; and erecting shop foreman gives time limit for erection and completion of order; the date is then set for shipment. If shipment date does not correspond with or fall earlier than the requested completion date of division engineer, notice is immediately sent to main office that an extension of time is required, and division engineer is so notified. This system gives to all construction officials a knowledge of when they may expect the completion of either manufactured or repaired work sent into these shops.

After a year's operation, with the handling of over 900 orders per month, it has been found that from 75 to 80 per cent of these orders are completed on the dates set in these foremen's meetings; that the other 20 to 25 per cent are completed within from two to three days after the date set. Orders can be handled in these foremen's meetings at the rate of about 1 every 40 seconds. The speed with which these orders are handled through foremen's meetings is due to foremen being allowed a full day to familiarize themselves with the orders before they are taken up in meetings, and the accuracy of the dates set is largely due to there being no delays in the procurement of material for the manufacture of the order.

While the planning department and shop system embodies some of the principal features of the various efficiency systems now being inaugurated throughout the United States, the nature of the work (largely repairing) and the variety of same has made it impracticable to carry out these efficiency systems any further than has been done. In addition care has been exercised not to allow the overhead expenses incurred by such efficiency systems to destroy or eat up the benefits derived from increased shop efficiency.

The cost of articles manufactured in these shops has in many instances been lower than the same items could be purchased in the United States, notwithstanding the fact of higher price of labor, vacation, sick and injury leave, etc.

The cost of repairs per unit of rolling equipment has increased during the past year, due to the age and deterioration of such equipment. For example, during the year 1910-11 this division renewed 4,109 boiler flues in all classes of locomotives; during the past year 23,616.

While additions and improvements have been made in the system and supervision of work in Gorgona shops during the past year, very few additions to buildings or new installations of machinery have been undertaken, it being

assumed that the life of these shops would not extend beyond the middle of 1913.

The repair of all classes of rolling and constructive equipment has necessitated the carrying in stock of a large number of steel castings, in that the average length of time to procure one of these repair parts from the United States has been from three to five months. In order to reduce the amount of this stock before the close of construction work, it was decided to install in foundry all necessary equipment for the manufacture of steel castings. A Tropenas 2-ton converter, blower, sand grinder, and all necessary apparatus, including an oven for drying molds, was purchased and put in operation February 1, 1912. Between February 1, 1912, and June 30, 1912, some 200,000 pounds of steel castings have been manufactured. In addition to this equipment enabling a large reduction in the stock of steel castings carried in storehouses, it is assumed that the same equipment will be an absolute necessity in the new permanent shops.

The gradual completion of construction work between Bas Obispo and Empire has during the past year decreased the number of units of equipment handled at both Las Cascadas and Gamboa, but a corresponding increase has occurred at Pedro Miguel engine house, which handles all equipment operating on south end of central division, as well as all the equipment of the Pacific division.

The work of removing material from top of slides on Gold Hill side of cut required the hostling of an average of from 12 to 15 engines at that point each night. No engine house was built, but a temporary repair shop and storehouse, consisting of two old box cars, together with the necessary storage and cleaning tracks, etc., were installed.

The Cocoli steel car repair yards on Pacific division were closed, all of this work being concentrated at Pedro Miguel.

At the close of the last fiscal year the Gatun machine and repair shop had been temporarily transferred from the Atlantic to the mechanical division to ascertain whether such transfer would not result in decreased overhead charges and more efficient operation. After a four months' trial these shops were permanently transferred to the mechanical division.

The mechanical engineer has under his supervision the work of the chief draftsman, testing engineer, boiler inspectors, material inspector, and requisition clerk, and, in addition to outlining and directing their work, prepares all specifications covering special requisitions for material and equipment for this division, acts in a consulting capacity on committees with engineers of other divisions when called upon, and, as chairman of the committee on standard specifications, prepares and submits specifications covering all standard material purchased by the commission. During the past year 50 of these standard specifications have been revised and submitted.

The chief draftsman, in charge of the planning department and all drafting, has had full jurisdiction over the extension of the planning department which has taken place during the past year. This department, as outlined above, is much more comprehensive in its scope, and prepares bills of material for all manufacturing work, including wood parts for car repairs. The whole system has been so developed and adapted to the needs of the shops that the economy and facility with which manufacturing work is handled is greatly increased.

During the past year this department has handled some 11,396 manufacturing orders, 2,933 of which were casting orders on foundry. This is an increase of about 75 per cent over the number of orders handled during the preceding year.

In the drafting room there has been prepared over 1,000 drawings and sketches, while 542 foreign drawings have been filed and indexed. Also, 1,380 pattern numbers have been issued and recorded.

All invoices of manufactured products covering more than one item have been referred to the drafting room for unit prices, and all invoices covering standard repair parts have been checked.

The drafting room has also prepared during the past year a complete inventory, with detailed description—including original price, present condition, estimated value, etc.—of all machine tools on the Isthmus and all rolling equipment. It has also prepared ground plans for the permanent shop buildings at Balboa, together with all machine location in such shops.

The equipment of the testing department has been increased during the past year by all necessary apparatus for the complete analysis of samples taken from each steel blow made in these shops. A testing machine of 100,000 pounds capacity has been ordered and will be installed in this department for the obtaining of breaking, yield point, and tensile strength of all metals manufactured.

The work of the department during the past year has, in the main, consisted of the analyses of steel, brass, babbitt metals, coal, and lubricating and fuel oil samples.

During the fiscal year, 1,206 tests and analyses have been completed, covering all classes of material and equipment. In addition, tests were made and records obtained of cutting speeds used in machine shop, with a view of increasing such speeds and the obtaining of greater efficiency for machines. Tests have been made of the air flow and air consumption of various divisions from compressed-air plants.

The work of boiler inspection department during the past year may be summarized as follows:

	Number.
Boilers visited	4,028
Internal inspections	1,213
Boilers tested by hydrostatic pressure	730
Boilers condemned	10

Some 1,670 recommendations were made to the heads of departments. It is to be noted that while the commission has in service over 4,000 steam boilers, no boiler explosion of any moment has ever taken place on the Isthmus. It is believed that the efficiency of this inspection service is responsible for the above result.

RAILWAY STOREKEEPERS' ASSOCIATION.

The tenth annual convention of the Railway Storekeepers' Association will be held at the Auditorium hotel, Chicago, May 19, 20 and 21, 1913. The subjects for discussion are as follows:

Regular Subjects.

"Reducing Inactive and Disposing of Obsolete Stock."

"Rolling Mills at Railroad Scrap Docks. Economy Effected."

"Couplers and Parts, M C B. Marking by Manufacturers for Identification."

"What Effect, if Any, Has a Well-Organized Store Department on the Operating Cost of a Railroad?"

The topical subjects which are to be continued are "standards" of the following: "Store House." "Store-House Casting Platforms," "Oil House and Waste Storage," "Dry Lumber Shed," "Stationary Store House," "Supply Car," "Scrap Dock and Reclaiming Machinery."

The above to be exemplified by necessary drawings, arranged on unit basis, so that any road may draw on such standards, according to requirements. Other topical subjects are:

"Specifications for, and Testing Material, and Effect on Storekeepers' Stock."

"Ice—Proper Method of Storage, Disbursement, Shrinkage and General Handling on Railroads."

"Standard Book of Rules Governing Store Department Practices."

Rotary Snow Plows

By H. H. Vaughan.

The development of the rotary snow plow has been chiefly due to Canadians and Canadian railways. This might be invidiously explained by the amount of snow which is supposed to fall in Canada, although as a matter of fact the difficulties experienced in dealing with snow are just as great on most of the roads crossing the Rocky and the Cascade Mountains in the United States as they are on those in Canada.

In both countries the rotary snow plow has been extensively used during the past twenty years, and it has proved so far to be the only effective appliance for dealing with deep drifts and snow slides that were beyond the capacity of the wedge or ordinary snow plow. The latter is still used extensively, and for drifts of moderate depth through which a reasonable speed can be maintained, it can be operated much more quickly than the rotary. When cuts are too deep, snow cannot be thrown out of them with a wedge plow, and in the case of slides the drift may contain rocks or trees, which would make the use of it exceedingly dangerous. The rotary plow can then be used to save the labor of shoveling out by hand, which would be the only resource, on account of its ability to encounter snow of any depth and throw it to a considerable distance on either side of the track.

The rotary snow plow was originally invented by J. W. Elliott, a dentist of Toronto, who in 1869 took out a patent on a "compound revolving snow shovel." This invention employed a wheel having a number of flat arms supported on a shaft rotating in line with the track. The wheel was enclosed in a casing shaped at the forward end to collect the snow, and flaring backwards to a cylindrical portion surrounding the wheel. This casing was open at the top to permit the snow being thrown out by the centrifugal force. The wheel was driven by a rotary engine, and while the design was obviously crude, it evidently included the principal elements of the modern plow. No practical use was, however, made of this invention, but the idea was later taken up by Jull, who improved the Elliott wheel by placing a knife or cutting wheel in front of it. This knife wheel was intended to cut the snow from the bank and pass it into the fan wheel behind it, by which it could be discharged through the top of the casing.

The Jull invention was taken up by the Leslie Brothers, of Orangeville, Ont., who proceeded to construct a full-size working model. The fan wheel was mounted on a hollow shaft, the knife wheel being carried on a solid shaft which passed through it. Both shafts were revolved in opposite directions through a system of bevel gears driven by a two-cylinder engine. The first working model of this plow was erected on the end of a flat car during the winter of 1883-84 at the Canadian Pacific Railway shops at Parkdale, but before its construction was completed, the winter was practically over. In order to test the invention, a bank of snow and ice was shoveled into a cut through which the Canadian Pacific tracks ran between Queens Wharf and Parkdale. The quantity available was limited, but it was clearly demonstrated that the Elliott principle of a revolving wheel could throw the snow clear of the tracks, as both snow and ice were thrown over 200 feet. This preliminary trial also showed that it was necessary for the plow to be so constructed that snow could be thrown on either side of the track, and that a flanger was required to prevent the plow being derailed in hard snow or ice and leave a satisfactory rail after it has passed through. With the Jull knife the direction in which the snow was thrown could not be changed as the wheel could only operate in one direction, and the opening in the top of the casing was fixed in position. The Leslie Brothers then developed a wheel with reversible knife or cutters, which could be changed in position to enable them to cut in either direction and a movable hood on the cylindrical portion of the casing through which the snow could be discharged on either side of the track. They also devised a suitable flanger or ice cutter, which was attached to the front truck of the plow. A full-sized complete plow of this design was constructed for them by the Cook Locomotive Works, of Paterson, N. J., and was operated on the lines of the Chicago & North Western Railway in Northern Iowa in 1885-86. It was then found that the principle of employing two wheels revolving in opposite directions was impracticable, as the friction caused by the snow passing between the wheels absorbed more power than that actually required to cut away and throw the snow. It consequently had to be abandoned, but the Leslies then devised a single wheel having knives or cutters directly attached to it, which automatically reversed in position according to the direction in which the wheel revolved. The plow with this wheel applied was tested during the same winter before the snow had entirely disappeared, and proved that the loss of power was overcome. It was then shipped back to Paterson, and rebuilt with the improvements that had been suggested by the season's experience. During the following winter, that of 1886-87, the improved plow, then known as the "Rotary," was given its first trial on the Oregon Short Line division of the Union Pacific, where it proved such a complete success that the railway company not only purchased it after its first trip, but placed orders for three more of the same pattern to be furnished in time for the following winter. The introduction of the rotary progressed rapidly from that date. They were adopted by the Northern Pacific, Chicago & North Western, Chicago, Milwaukee & St. Paul, and many other roads in the United States, while in Canada eight were constructed by the Canadian Pacific Railway in 1888 at their Montreal shops through the Polson Iron Works Company, of Toronto. The first of these plows, No. 101, had a wheel 9 feet 10½ inches in diameter, a boiler having 1,259 square feet of heating surface carrying 180 lbs. pressure, and a two-cylinder engine 17 inches diameter by 24 inch stroke. The cab was of wood, a point of weakness on account of the heavy bending strain to which it was subjected when the lower portion of the casing was forced into hard snow. The side frame, which was a heavy 12-inch channel running from end to end, was tied together by the main bearing casting and engine shaft casting at the front and end from the latter, two inner frames extended to the back end. These supported the cylinder saddle and the boiler carriers, and were connected to the side frames by gusset plates. The structure was fairly strong longitudinally, but as later experience proved it did not possess the necessary vertical strength for the work it was subjected to.

The wheel with which these plows were fitted was known as the square fan type. The back was a sheet of steel plate to which longitudinal gusset plates or partitions were attached, which in their turn supported the front rings and the trunnions for the knives or cutters. The action of these knives can be readily understood. In whichever direction the plow was turning the resistance of the snow would tend to force the knives into a position in which they would cut

*From a paper read before the Canadian Society of Civil Engineers.

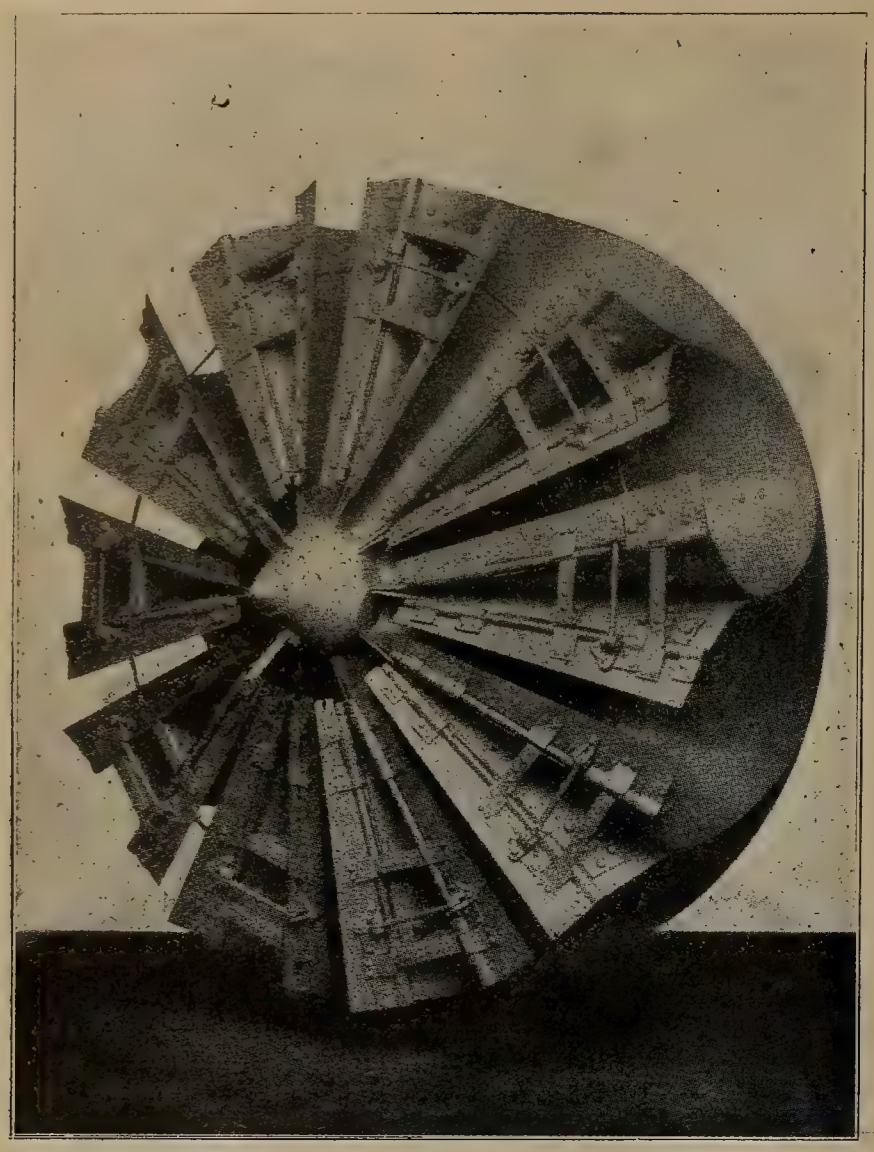


Fig. 1—Scoop Wheel.

the snow, and deliver it into the compartments. Then, on account of the centrifugal force due to the revolving wheel, it would be forced against the casing until the opening was reached, when it would fly out in a straight line. This wheel proved satisfactory when handling the dry snow found east of the Rockies, but in heavy work the partitions were not sufficiently strong to drive the knives. As the men on the plows put it—"The back ran away from the front." To overcome this and handle the damp snow found on the western slopes, the Leslie Brothers introduced the scoop wheel shown in Figure 1. In this wheel the pockets or compartments are conical-shaped scoops strongly secured to a cast iron or cast steel center. The knives are carried on the edges of the scoops, and the knives on the adjacent edges of each pair of scoops are connected together by links so that as one knife is cutting the snow, the other is pressed down to afford the necessary clearances. This style of wheel entirely superseded the older square fan type and has since been used.

The construction of the plow as a whole has not changed radically with the exception of the special plows which will be described later. The wheel has been increased in diameter, 11 feet being now the usual size. The engine and boiler capacity have been increased, the engine to 18 inches diameter by 26 inches stroke, the boiler to 200 lbs. pressure with 1,852 square feet of heating surface. The bevel gear drive was changed to employ two bevel pinions with independent engine shafts, the bevel gears and pinions being made of steel with cut teeth in place of the cast iron gears originally used. The knives which were originally made of steel plate were greatly increased in strength and made of cast steel. Cut wideners were added to the casing to enable the banks to be cut away and the strength of the casing greatly increased, especially at the cutting edges. Figure 2 shows the construction of the casing, and attention is called to the flatness of the surfaces at the corners, which give trouble on account of ice forming there when the plow is forced into the snow. A plow was constructed for the Canadian Pacific Railway in 1911, to which cut wideners were applied, which when not required can be folded back against the sides of the casing, the rods which hold them in position being then removed.

The development which has taken place in the rotary snow plow has, without any question, proved that this is the only successful plow of its type and the means by which trains have been operated during severe winter weather. It is difficult to imagine how the railroads of the United States and Canada could have operated without it with the amount of traffic they are now called upon to handle. There have been many attempts to develop other styles of steam-driven plows, but none have been found as powerful and efficient as the rotary, and none are today in actual use. The experience on the Canadian Pacific Railway showed, however, in the opinion of its officers that good as the rotary was, it was not good enough. It is only fair to Mr. Leslie to say that he does not agree that the rotary was properly operated on the Canadian Pacific Railway, and to a great extent his opinion is no doubt correct. On the other hand, the heaviest service a plow is subjected to is when cutting its way through snowslides, and unfortunately these are met with on every road that operates to the Pacific Coast. The snow in a slide is not only packed exceedingly hard, but it is liable to contain trees and rocks which are carried with it down the mountain side. No plow can, of course, handle such obstructions and when they are discovered they are either pulled out or blasted away. There is, however, a very strong pressure on every railroad at the present day to open up the line in the shortest possible time, and to effect this the usual method of operating a rotary was to put two heavy engines behind it, run the plow engine as fast as possible and drive it into the cut at 8 or 10 miles an hour. As the plow slowed down it was drawn

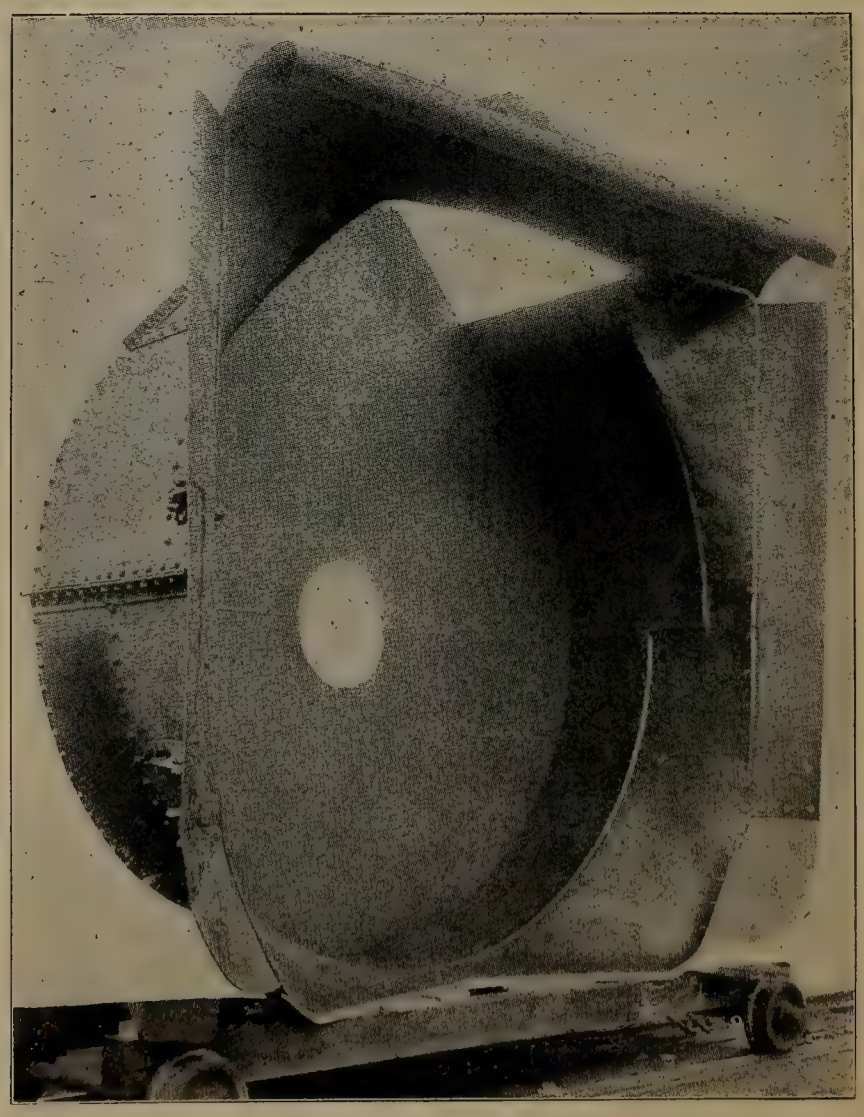


Fig. 2—Plow Casing.

back, speeded up again and the operation repeated. If trees or rocks were met with the knives were frequently torn off or damaged and their repair was an extremely difficult and tedious job. In addition, two points that have been referred to, the formation of ice in the casing and the weakness of the plow frame, were a constant source of trouble, apart from the time that was taken to clean out a cut of any length. During the winter of 1908-09 G. J. Bury, then general manager of the Canadian Pacific Western lines, was engaged for a considerable time in operating rotary plows, and decided that a plow was required that practically could not break down and that would have sufficient power and strength to cut its way through any snow bank. His instructions were that he wanted a plow with knives of two-inch armor plate and the rest in proportion. Authority was given the following spring for two plows to these specifications and arrangements were made with the Montreal Locomotive Works for their construction. John Player, consulting engineer of the American Locomotive Company, was engaged to prepare the design in collaboration with the writer, and it was decided to modify the construction of the regular rotary plows considerably. The writer had for some years believed that better results could be obtained by driving the plow wheel direct in marine engine style than through the bevel gears previously used, and that the frame of the plow should resemble a bridge girder to thoroughly support the casing or hood in place of the channel iron frame which required bracing to prevent its bending. After some preliminary designs had been prepared it was decided to adopt these suggestions, and as the work progressed a number of novel features of construction developed. One of the most important questions was that of obtaining a wheel of greatly increased strength. The use of a knife blade two inches thick with a corresponding construction behind it would have led to a weight that was impracticable, but the wheel as actually built is immensely strong and radically different from those previously employed. The cone-shaped scoops, which have been illustrated, were formed from plates of ⅜-inch steel pressed into shape and the hinges for the knife blades were riveted to their edges. To obtain the desired strength these plates would have to be increased to 1¼ inch or 1½ inch, which would make them most difficult to form and necessitate the hinge castings being fitted to them individually as it could not be expected they would be absolutely uniform in shape. It was therefore decided to make the entire wheel out of cast steel, casting the hinges solid with the body of the wheel. As no machinery facilities or annealing furnaces were available for handling a casting of this size in one piece, the center was made in octagon form, 80 inches across the flats, with 8 segments bolted to it. The faces at the center were machined and hinge holes drilled. Stops were provided against which the blades bear when cutting. The hinges are 6 inches in diameter at the largest part and the hinge pin 2½ inches in diameter. The bottom holes in line with the hinge holes are for the 2¼-inch bolts which secured the segments to the center. There are three of these bolts in each segment, one in line with each hinge hole and one central between the hinges. There are also 5 bolts, 2 inches in diameter through the flanges at their rear edges. It was necessary to make the fastenings between the segments and the center of ample strength, not only to stand the shocks at the edge of the blade, but the effect of centrifugal force which at 400 revolutions per minute, the estimated maximum speed, was equal to about 275 times the weight on a diameter of 11 feet.

Figure 3 is a view of the wheel assembled before the knives are attached. This view shows the band, 1¼ inch on each end, which fit in grooves cut in the segments and is also securely bolted to them. It is increased in thickness to compensate for the holes for the hinge pins and bolts. This view also shows the bolts attaching the segments to the center and the stops for the knife blades. The blades are of massive construction and have three hinge thick by 10 inches wide, which further secures the segments in place. This band is made in sections with L-shaped lugs

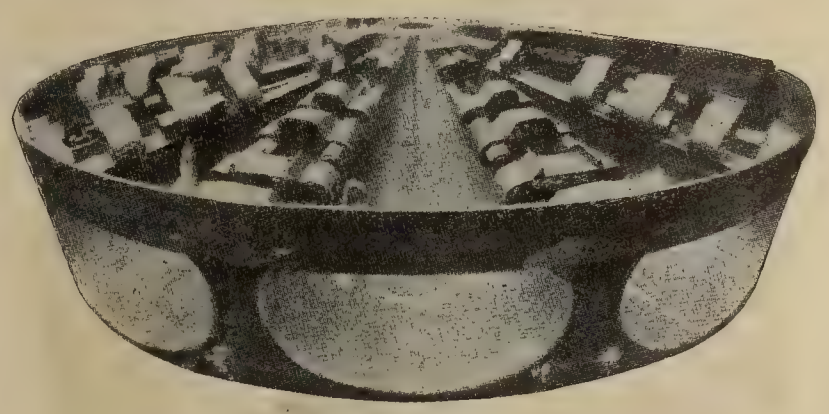


Fig. 3—Wheel Before Knives Are Attached.

pins, 1⅜ inch, 1⅝ inch and 2¼ inches in diameter respectively. The hinges on the wheel and on the knives are sufficiently strong to bear these pins and it was calculated that to shear the outer pin, which is the one exposed to the greatest strain would require 400 tons at the edge of the blade. The knives are ⅝ inch thick at the edge and heavily ribbed, while the stop extends from end to end and forms a strong backbone.

The complete wheel was balanced at the shops without the nose pieces. In this condition it weighed 24,000 lbs. and on account of the high speed at which it was required to run it was necessary to balance it most accurately. Links were provided connecting each pair of knives to move the rear knife into the proper position. The machined surface near the link was to permit of the attachment of clips to hold the knives in their proper position, but these were not required when the proper length of link was obtained. A front view of the wheel in place in the plow (figure 4) will clearly show the general strength of its design.

The casing of this wheel was made of ¾-inch plate in two tapered courses, the front one being tapered 1 to 1½, the back one 1 in 4. In place of making the front of the casing in a vertical plane, the taper course was cut away to bring its cross section to the shape required. By adopting this plan all flat surfaces which might lead to the formation of ice were avoided. The front casing is reinforced by a second thickness of ¾-inch plate along its lower front edge, and heavily braced with tee irons. The back of the casing is constructed of steel castings, having flanges for attachment to the gusset plates, which are securely riveted to the frame. This view also shows the taper wheel fit of the main shaft which is 11⅛ inches diameter and 12 ft. 2 in. long over all. The front bearing is 11⅛ inches diameter by 28 inches long. Behind this is a marine type thrust bearing having 10 collars and a rear bearing 10 inches diameter by 16½ inches long. The thrust bearing was introduced on account of the conviction that the arrangements for taking the thrust were inadequate on the older plows, and in their case the thrust was actually taken by the sheet of ice which formed between the plow wheel and the casing. This has been justified by the results as the plow runs very freely on heavy cuts. On the rear end of the main shaft is a crank disc connected to the crank pin of the engine by a drag link coupling. This was used in case of variation between the alignment of the main shaft and the engine crank shaft and to prevent any bending strains being transmitted from one to the other. On one

plow there is actually a difference of ¼ inch which is easily taken care of in this way. The engine is of strong but light construction, the cylinders 20 inches diameter, 24-inch stroke, are of grey iron cast in one with the steam chest and bolted together. The columns are of cast steel and their shape was carefully worked out. On account of head room the length of connecting rod is very short in proportion to the stroke, only 1.87 to 1, which required ample bearing surface in the crossheads. This feature has, however, given no trouble. The reverse lever and throttle are in duplicate, so that the plow may be operated from either side. On the casing is the steady block arrangmnt. This comprised a shoe on either side of the casing which can be forced down on the rail to steady the plow when taking heavy cuts. It is operated by an air cylinder, but this has not proved satisfactory and is to be changed to a hand lever.

The frames are box girders 36 inches deep at the front end, the outer plate being ⅜ inch thick, the inner ½ inch. The top and bottom flanges are 13-inch ship channels and the frame is carried back full depth to the boiler saddle where it tapers down to 18 inches deep at the back end. This view also shows the heavy steel front casting, the ¾-inch plate which connects the frames together at the bottom and the shaft bearing and engine-supporting angles.

The engine crank pin in front is for the drag link, the pins are hollow and in many respects weight has been saved as much as possible. The operating platform is supplied with the engineer's valve of the Westinghouse air brakes, and also the straight air brake valve. Other valves control the flanger, ice cutters and steadying blocks, all of which are operated by compressed air. Slides in the center carry the bracket for the electric headlight, which can be lowered down into the cab when required.

The boiler applied to these plows is similar to that on the Canadian Pacific Class M-4 Consolidation locomotives, with the exception that the superheater was omitted. It was thought that as the plows would only be used a few times each year the economy resulting from superheating was unimportant, while the possibility of the apparatus leaking or not being in perfect order when required would be objectionable. The boiler contains 2,108 square feet of heating surface and 44 square feet of grate area, and carries 200 lbs. pressure. It is, therefore, of far greater capacity than any previously employed on this class of work. The trucks are of the six-wheel type, but of special design, having cast steel frames. The axles are the M. C. B. 50,000 lbs. standard with 7-inch by 12-inch journals, and the wheels 34 inches diameter with steel tyres. On account of the plow having no center frames, but simply two main longitudinal girders, no weight is carried on the center plates, which are used simply to guide the trucks, and the weight is carried on sliding surfaces located between the side frames of the trucks and the plow girders. On account of there not being sufficient room the usual type of truck equalizer could not be applied, and underhung equalizers are used which bear on pins in lugs cast on the boxes. To save weight the end pedestals are dispensed with and the frame is formed with guides, which engage with grooves on the journal boxes. This design of truck is exceedingly light for its strength, and with certain exceptions that will be referred to later, has proved satisfactory. Their size may be judged from the frame being 48 feet, 4 inches long over all from the casing to the rear end. They weigh 260,000 lbs. in working order, the weight being practically equal on the two trucks. The cab or covering is of steel and is smooth inside, the angles and braces being on the outside to avoid injury to the men in case of derailment. The tender attached to the plow has a capacity of 7,000 gallons of water and 16 tons of coal. It was made specially long, 32 feet over end frames, in order to separate the weight of the plow from the engines pushing it on account of bridge limitations. The tender trucks are inside bearing four-wheel equalizer pedestal trucks, this design being adopted to use engine truck wheels and axles of standard types.

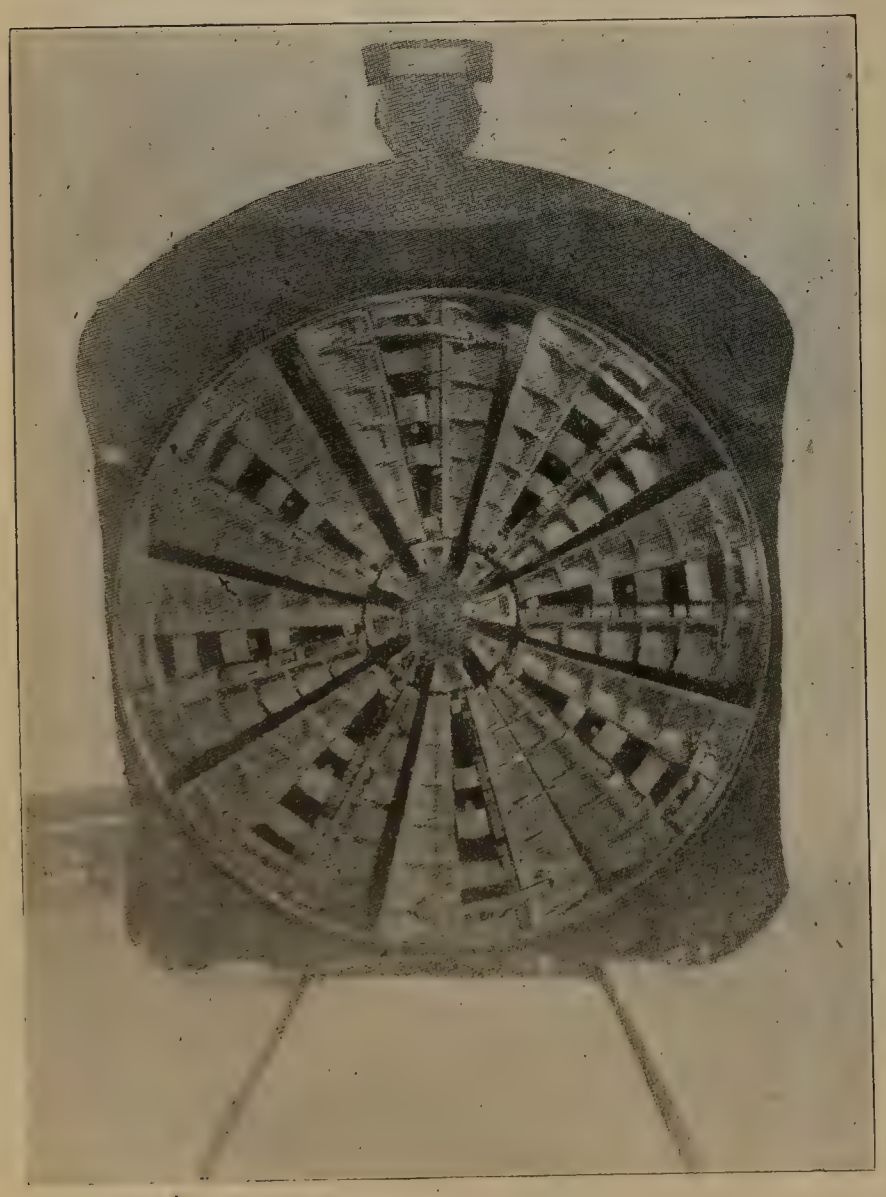


Fig. 4—Wheel in Place.

The design of these plows was commenced in July, 1910, and a considerable amount of preliminary work was required before it was possible to decide on the general plan that would be practicable. In addition it was desired to apply the new type of wheel and casing to several of the older plows in service, and in order to do this in time the design of the wheel had to be completed before the balance of the work was taken up. About the 1st of October it was possible to prepare an estimate of the weight of the complete plow, when it was found that it would greatly exceed the limits that had been allowed by the bridge department. The wheels which were constructed at the Angus shops, were by that time partly completed, so that it was necessary to revise all the other drawings and practically redesign the entire plow. In fact, there was hardly a pattern or a drawing that did not require making up anew, with the exception that the only alteration of the boiler was to shorten the barrel. In spite of this delay, the first plow was completed by the Montreal Locomotive Works on January 8, 1911, and the second one a few days later, a remarkably quick piece of work in view of its size and every part being entirely new in design.

It is difficult to say whether these plows have proved entirely satisfactory in service. From the time they arrived in the mountains there has been no trouble with snow that would test their capacity. They have been run through a drift of hard packed snow about 250 yards long without slowing down, and pushed by one engine in place of requiring two, as would have been the case with the old plows. This indicates that they have ample power and steaming capacity. One of the Western officers of the Canadian

Pacific states that they will cut trees four inches diameter, but they have not been tried on anything heavier. Last season the man in charge, while going through a cut, felt a jar and saw a car coupler which had been left in the drift, thrown out to one side. The only damage is reported to have been a semicircular piece about 2 inches in diameter broken out of one of the blades. With these exceptions, it has been difficult to obtain any definite reliable information. The plows do, however, work exceedingly well. There is an entire absence of the noise and vibration which makes the operation of a bevel gear-driven rotary so unpleasant. The plows are so strongly constructed that it is difficult to see how any obstructions could injure them, and from what experience has been obtained, it is expected that they will be of great assistance in keeping the road open under any conditions.

The only trouble that has been experienced is through derailment. When the track is badly heaved, one spring on an equalizer may be compressed until practically solid and thus change the actual fulcrum of the equalizer. This has been overcome by placing a seat between the springs and the equalizer to ensure a constant point of application of the load and placing springs between the truck frame and the supporting plates. These were required on account of the small amount the plow frame can be twisted. When supported on one side only the opposite side was found to be ⅛ inch lower. This shows the stiffness of the frame construction and explains why additional spring movement was necessary to compensate for the irregularities of the track.

While during the past few years the tendency has been to depend on wedge plows rather than rotaries for the general work of clearing away snow, still the rotary is called on when the limit of the wedge plows is reached, and for work they cannot safely attempt. The energy and perseverance of the Leslies led to the practical development of the rotary snow plow, and they deserve a great deal of credit for furnishing the railroads with a machine that has rendered winter operation possible.

SPECIFICATIONS.

A paper on this subject was read before the Western Railway Club on December 17 by O. S. Beyer, of the Rock Island Lines. The following are extracts from the paper.

The lack of the use of good specifications in the many cases where they might be employed with benefit demonstrate that their importance and value are not fully appreciated. Specifications are important and valuable for the following benefits which result from their use:

(a) Bidders are placed on a strict and fair competitive basis regarding quality as well as price.

(b) The selection of the most desirable bid is simplified, and controversy and criticism are minimized when awards are made.

(c) The field from which materials and equipment are selected is broadened since trade names are ignored and comparatively unknown materials and equipment offered by responsible bidders may be accepted without detriment to the purchaser.

(d) The railways are insured against the delivery of imperfect, poor or wrong materials and equipment, and they are saved disputes and troubles arising from the condemnation of and the use of inferior, unsuitable and inadequate material and equipment.

(e) A definite basis for acceptance or rejection is established.

(f) Constant inspection and analysis and record of service rendered by materials and equipment made to specifications furnish a check on the practical results obtained, and also furnish additional information and experience which are helpful in effecting improvements in the specifications and hence in future supplies and equipment purchased.

The organizations required to secure the full benefit of specifications are:

An inspection and test department.

A mechanical engineering staff.

A thoroughly organized test department with a full quota of inspectors under a competent engineer of tests is absolutely necessary to insure the furnishing of materials and equipments strictly in compliance with specifications. Just as the peace of a nation is insured by a strong, well organized navy, so is the furnishing of suitable materials, machines, special equipment, cars and locomotives safeguarded by a strong, capable inspection and test organization. The policy of railways should, therefore, be to maintain a well balanced test department.

The preparation of good, thorough specifications is the duty of the mechanical engineer and his staff, collaborating with the engineer of tests and the practical men in the field. However, the mechanical engineering staff is often too limited in number to fully and properly study and prepare such specifications. The extremely short time usually granted in which to prepare plans and specifications is another serious condition which prevents the turning out of sufficiently comprehensive specifications. The great good which a thoroughly organized engineering staff can accomplish by carefully studying equipment selection in relation to the many conditions which affect it, the investigation of new and improved devices, methods and materials and the preparation of complete and accurate plans, should be more thoroughly appreciated. The experts of many of the leading supply and engineering firms are always willing and ready to co-operate with the mechanical engineer and his staff.

The return from a complete and capable mechanical engineering organization is not direct, and can hardly be proven by simple figures. Hence, perhaps, the reluctance with which the pay-roll is increased to make possible the employment of draughtsmen and engineers to prepare first-class and thorough plans and specifications. This reluctance should pass away when the entire situation is logically viewed and the great benefits which result, from the good work of a competent mechanical engineering staff are considered.

The introduction of specifications is simply the introduction of order and system into a field where such order and system have been lacking. It is within the power of engineers of test and mechanical engineer to bring to a greater realization the benefits which result from specifications, by thoroughly studying the entire field and preparing specifications so that they will comply fully with the characteristics of good specifications laid down in the forepart of this paper. It is hoped that greater uniformity in the detail requirements of the specifications of different railroads covering the same material will be effected, that standard forms for different specifications covering materials, machine tools, cars and locomotives will be adopted. that co-operation between the various technical societies, manufacturing companies and railway companies will become more general, and, lastly, that the use of carefully prepared specifications will be more appreciated and will become more extended.

IN THE OFFICE of J. G. Neuffer, superintendent of motive power of the Chicago Great Western, is posted this notice: "Unless you are willing to be careful to avoid injury to yourself and fellow workmen, do not ask for employment. We do not want careless men in our employ."

TWO STAGE AIR LOCOMOTIVES.

Compressed air locomotives are in many classes of work, more desirable than electrically driven locomotives or those operated by any other form of power.

Compressed air locomotives are single stage and two stages. The single-expansion compressed-air locomotives are of the well known type using air at a pressure of from 600 to 1,000 pounds stored in a single large reservoir from which the air is drawn through a reducing valve set to maintain a pressure of about 150 pounds at the throttle valve. The use of a reservoir for a boiler and reducing valve to regulate the pressure are the only features essentially different from a single-expansion steam locomotive.

For half a century these locomotives have been used in gradually increasing numbers for operation in mines where the absence of fire, smoke, sparks, and electric wires was particularly desired, this in spite of the fact that they operate at a rather poor efficiency.

The two stage type, it is said, will do from forty to sixty per cent more work with the same quantity of air, thus reducing the cost for power about 30 per cent and reducing the size of the compressors and boilers, 30 per cent, as well as reducing the first cost of installation, approximately 15 per cent while increasing by 30 per cent the distance which the locomotive will travel on one air charge.

Figure 1 shows one of ten gathering locomotives used by the Vesta Coal Company. This locomotive has a high pressure cylinder measuring 6' by 12 inches and a low pressure cylinder measuring 12 by 12 inches. With a weight of 15,000 pounds, the tractive force of the locomotive is 3,000 pounds and its rigid wheel base is 4 feet. The diameter of driving wheels is 24 inches, and the gauge of track is 48 inches. The extreme width of the machine is 6 feet 4 inches, while its length is 12 feet 6 inches.

Another air engine which is of special interest is that shown in Figure 2. This locomotive has a haulage engine attachment and is utilized by the Lehigh & Wilkes-Barre Coal Company of Wilkes-Barre, Pa. There are three of these locomotives in service, each having 6 and 12x12 operating cylinders and haulage cylinders measuring 4½ and 9x8, while the weight of the locomotive is 18,000 pounds.

They are intended for use on the level gang-ways of the anthracite mines in pitching seams; where the rooms are driven up the pitch, and where the degree of pitch is too steep for the operation of traction locomotives and not steep enough for coal to run satisfactorily in a chute. In operation the locomotives stay on the entry and the rope is pulled off the drum and used to haul the empty car up the pitching chamber, or as a brake in lowering the loaded car down.

In the two stage locomotive the compressed air, of course, expanded in two successive cylinders, providing for a wider range of expansion, with higher initial and lower terminal pressures, thereby securing many of the advantages which compound cylinders give where steam is used, except that in the case of air there can be no cylinder condensation.

The effects of a wide range of expansion in a single cylinder, with the resultant great difference in temperature, are, none the less, of serious consequence, causing as they do a temperature of the cylinders and port walls considerably below that of the incoming air with initial refrigeration and a serious shrinkage in volume.

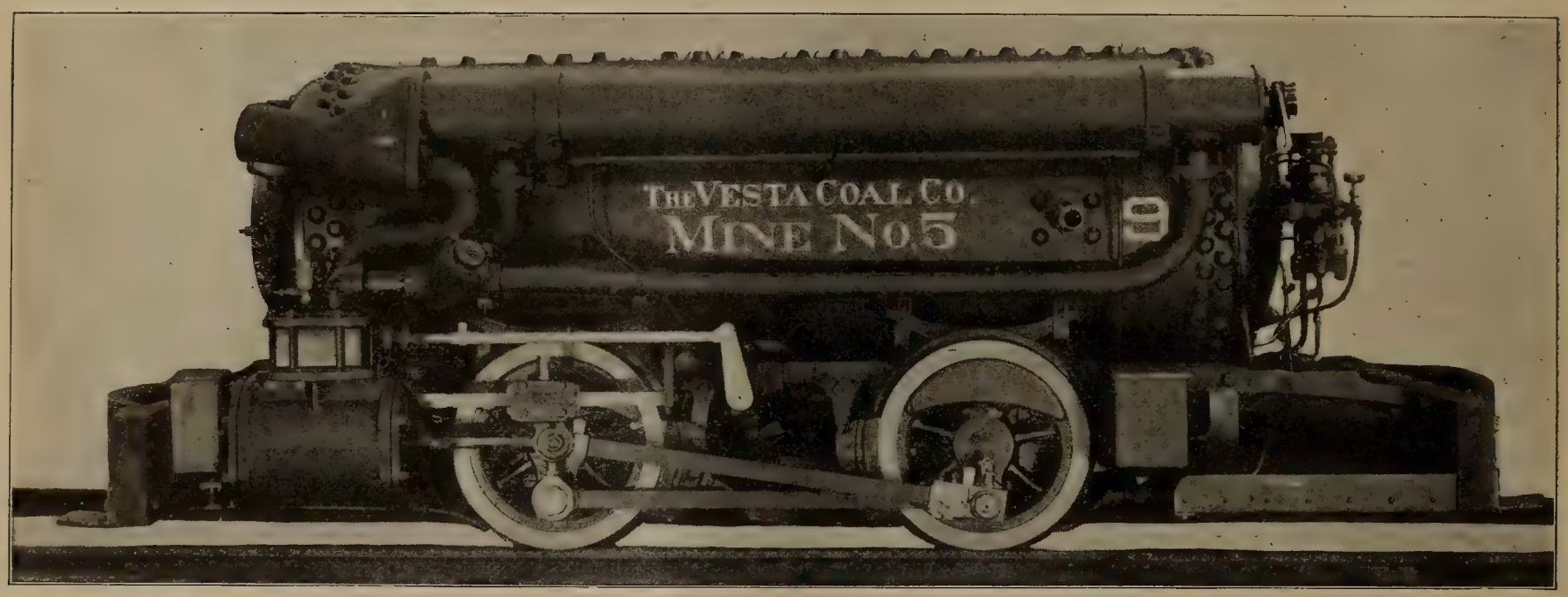


Fig. 1—Two-Stage Compressed Air Locomotive, Vesta Coal Co.

Fig. 2—Two-Stage Compressed Air Locomotive, Lehigh & Wilkesbarre Coal Co.

In addition to this, which is the principal reason for compounding with steam, there are various other considerations which render the expansion of compressed air in successive cylinders either more advantageous or an utter failure, depending upon whether advantage is taken of the radically different conditions under which the two fluids operate. The differences in conditions are due to the steam engine being a primary machine for the conversion of the heat derived from coal or other fuel, into work. To obtain the best results, all losses of heat must be avoided, as the pressure and vaporized conditions have been caused by heating the water, and when the excess heat above that of the surrounding materials has been lost, the water again becomes inert and incapable of work. The excess heat of the working fluid above that of the surrounding natural objects is, then, the real source of power.

It is maintained that with air the sensible heat of compression and the sensible refrigeration of expansion are unavoided evils which must be reduced to a minimum. If the heat of compression could be taken away fast enough to keep the air down to its natural temperature during the entire process of compression, and if heat could be supplied during expansion fast enough to prevent any cooling below that of surrounding objects, or if all of the heat of compression could be retained until the air reached the cylinders in which it is to be expended and do work, compressed air would be 100 per cent efficient barring the losses due to friction of the compressing and expanding engines. Unfortunately, both plans are impossible, more particularly in the case of locomotives.

The air must be compressed and expanded so rapidly that there is no time either to extract the heat of compression while the air is in the compressor cylinders, or to prevent refrigeration while expanding in the cylinders of the locomotive; and any heat remaining in the compressed air after it leaves the compressing cylinders is unavoidably lost before it reaches the working cylinders of the locomotive, because of the necessity for storing the air for considerable periods of time in tanks and pipe lines in order that the locomotive may be charged promptly and at various stations frequently spread over an area of several thousand acres.

Compression of air without heat has been approximated by performing the operation in successive cylinders of decreasing size, with intercoolers in which the heat due to the preceding compression is removed. The intercooler consists of a casing filled with small tubes through which cold water is circulated. The air passing through the casing and around the tubes is thoroughly cooled before it enters the next cylinder. All compressors for charging locomotives are of either the three stage or four stage type, with either two or three intercoolers, reducing the heat losses from 96 per cent to 17 per cent, based on isothermal compression.

With more stages the heat losses could be further reduced, but only at the expense of cylinders and intercoolers that the reduction in heat losses would be more than balanced. A great saving in the power required to compress air having been effected by intercooling with water at atmospheric temperature, it was only a short step to the reversal of this process interheating with water after partial expansion in a high pressure cylinder, before the air entered the low pressure cylinder.

This method of utilizing compressed air for driving pumps has been adopted with marked success and greatly increased efficiency, as the water which the pump was moving could readily be circulated through the interheater. It was a longer step to the reversal of the process and the substitution of atmospheric air, the only available heating medium which could be drawn on continuously while the locomotive was in motion.

Several years ago a series of experiments were made at Pittsburgh, Pa., with atmospheric interheaters in connection with two stage locomotives of the Porter type. It is held that the atmospheric interheater made possible a number of incidental improvements as it provided for a higher ratio of expansion, with higher initial and lower terminal pressures, without unmanageable refrigeration, just as stage compression made possible higher pressures and higher ratio of compression without unmanageable heating.

C. B. Hodges of Pittsburgh, Pa., an expert in compressed air haulage, holds, that, while compressed air locomotives have their limitations, and are of not intended for long continuous runs in one direction, and their efficiency would be relatively low where starts and stops were infrequent, there would seem to be a wide field of usefulness, more especially where waste heat from heating or blast furnaces, or the refuse from wood working establishments, or water power, could be utilized to operate the compressor, thus saving the fuel necessary to operate steam locomotives, doing away with trolley wires and eliminating all risk of fire.

It is pointed out that the Navy Department of the United States has during the past decade used a number of compressed air locomotives for naval magazines at various points on the Atlantic and Pacific Coasts. The advantages of this type of locomotive for this service are too manifest to require explanation, as there is nothing about it warmer than the surrounding atmosphere, and it exhausts nothing but pure air.

These locomotives are of various sizes from 6 tons up to 30 tons. One of the largest is used at the United States Naval Magazines at Hingham, Mass. The complete haulage plant consists of the locomotive, two electrically driven air compressors delivering air at 1,100 pounds pressure, a battery of 8 storage tanks, each 32¾ inches in diameter and 20 feet long, 600 feet of 6 inch pipe, and two charging stations, one in the locomotive house and the other out on the main line of the railroad. The locomotive is charged to a pressure of 800 pounds in about 2½ minutes. It will then travel a distance of about 4 miles, hauling 4 or 5 standard freight cars.

The reservation railroad consists of 9,600 feet of main line with numerous short branches to shell houses, magazines and the power house. The locomotive is used for hauling ammunition from the N. Y., N. H. & H. R. R. side track to the magazines and shell houses and from them to the wharf for delivery to the ships of the navy.

Each of the two compressors has an actual capacity of about 190 cubic feet per minute. When compressing this quantity of air to 1,100 pounds pressure the electric mofor driving either compressor required about 60 kilowatts.

It is maintained that an ordinary charge for the locomotive is 15,000 cubic feet of free air, so that one compressor will supply about six charges per day of eight hours, sufficient to move the locomotive with service loads a distance of from 20 to 25 miles.

With both compressors in operation the locomotive could travel from 40 to 50 miles under the same conditions. The tanks and pipe line are normally filled with air at 1,100 pounds pressure, so that by equalizing the pressure through the charging station the locomotive is charged in less than two and one-half minutes.

The stationary storage is in this case unusually large; in fact, it is sufficient to operate the locomotive for half a day or more under ordinary reservation requirements without starting the compressor.

The Hingham locomotive has a high pressure cylinder 11 inches in diameter by 18 inches stroke and low-pressure cylinder 22 inches in diameter by 18 inches stroke. The tractive force is 10,000 pounds and the wheelbase 5 feet 9 inches. The weight on drivers is 60,000 pounds and the

capacity of main reservoir is 375 cubic feet. The main reservoir consists of three cylindrical steel tanks, 40 inches outside diameter. The regulating valve is set to maintain a uniform pressure of 250 pounds at the throttle valve.

The noteworthy features of this locomotive are the atmospheric interheater and the unusual cylinder ratio of four to one in volume. The interheater consists of a cylindrical reservoir filled with small tubes. The air in its passage from the high to the low pressure cylinder travels longitudinally through the interheater in a zig-zag line back and forth across the tubes with which the interheater is fiilled. The exhaust from the low-pressure cylinder is utilized to create a draft through the interheater tubes, thus bringing large quantities of atmospheric air into close contact with the refrigerated air from the exhaust of the high-pressure cylinder.

In this apparatus practically all of the heat lost due to the work done in the high-pressure cylinder is restored and the air is delivered to the valve chest of the low-pressure cylinder at practically atmospheric temperature, giving substantially isothermal instead of adiabatic conditions for calculating the relative volume of the cylinders.

It is held that the atmospheric interheater, in addition to changing the ordinary cylinder ratio for locomotive practice, also greatly increases the efficiency and removes a serious obstacle to the efficient use of compressed air. On numerous tests, locomotives of this type have shown an efficiency fully 50 per cent better than the simple compressed air locomotive.

The reason why two stage expansion with the compressed air locomotive is more advantageous than with the steam is readily explained by the fact that a higher initial pressure does not call for additional fuel, as the air must in any case be raised to a very high pressure in order to obtain adequate storage within a reasonable bulk, and by the equally important fact that interheating between the two cylinders costs practically nothing.

With the steam locomotive, interheating between the two cylinders requires heat derived from coal or other fuel burned in the firebox. It may be obtained from the heated gases in the smokebox or from live steam, but in any case this heat is equally available for other purposes so that the benefits derived from it are not dependent upon compounding. With the compressed air locomotive, the air in the main reservoir being at atmospheric temperature, a partial expansion in one cylinder reduces the temperature below that of the atmosphere, thus rendering the atmosphere a heating medium, and after that a second and larger cylinder utilizes the benefits derived from the interheating, so that heating by free air with beneficial results would be impossible without compound cylinders.

THE PANAMA CANAL terminals at Cristobal and Balboa are to be supplied with facilities for supplying both the canal and shipping with fuel oil. There will be two tanks at each terminal with a capacity of 40,000 barrels, with provisions for additional tanks.

THE ENGINEERING EXPERIMENT Station of the University of Illinois has undertaken the study of the effect of certain boiler waters on the strength and brittleness of steel in boiler plates.

Every man who is worthy of the name, spikes down good resolutions to the home ties.

* * *

Common sense and elbow grease are the best lubricators to use on a refractory engine.

* * *

If you have been wheeling 'em pretty lively with the boys, it would be well to observe the slow board.

FREIGHT CAR DELAYS.

By F. M. Lucore.

To intelligently treat of car delay, it is essential that a common understanding be reached, as to what delay is. Each of us may think he knows perfectly well what constitutes delay in its broad sense, but the likelihood is that each has in mind some particular phase of delay. Having decided what is 100 per cent car service, it is possible to reach an opinion as to what is 50 per cent or 75 per cent service.

My subject requires me to point out some of the causes which produce a car service of less than 100 per cent, and to indicate the remedies. In undertaking this it is deemed expedient to deal with empty cars separately from loaded ones.

I suppose the ideally handled empty car—the 100 per cent car—is repaired as soon as it becomes in bad order and is then placed for loading as soon as lading presents itself.

In the case of the home car, the ideal handling, the 100 per cent handling, is to place it in good repair during the dull season of the year. Sidetracking it in bad order during dull periods, waiting until loading is at hand and then repairing it, often makes it a 75 per cent or perhaps a 50 per cent car.

The ideally handled foreign car—the 100 per cent car—is let us say, one which as soon as it becomes in bad order is repaired; and when in good order is promptly moved to the nearest point where it may properly be loaded. When this is not done, delay in returning the car to the service of transportation results, and it may on that account become a 75 per cent car or a 50 per cent car. The fact that a car is immediately sent to its owner does not necessarily place it in the 100 per cent class. The measure of efficiency is, how soon the car returns to the service of transporting freight. The road on whose tracks the car is located should repair it, and this will be made more practicable than now by standardizing car repair parts. The car, standard in dimensions, standard in design, with a standard minimum strength requirement is on the way.

The making of repairs as fast as they develop is necessary in order to have a 100 per cent car. This is especially true in the case of cars belonging to other than direct connections, because such cars are long distances from home and when they are hauled empty in a direction in which they could properly be loaded, it obviously reduces the car supply.

The mechanical and transportation people, by joining hands more closely, can utilize foreign cars on their return homeward movement more than is done today and thus work toward the 100 per cent car. Even in times of car shortage the practice to a surprising degree is, to repair foreign cars when repairs can be made by one man in one day. If more time is required, it is not unusual for the cars to be sent home empty without regard to how short of cars the transportation people may be. This is done on the theory that the road has more bad order cars of its own than it can repair. Of course a road will have lots of its own cars to repair during busy seasons when help is scarce if a minimum of reciprocity exists between railroads in repairing each other's cars.

With this practice in vogue, of moving cars empty simply because repairs are needed to put them in shape to carry a load, the available car supply in total is seriously decreased and the extent to which this practice obtains is perhaps not generally realized. Any lack of reciprocity reduces the available car supply and makes more difficult the attaining of the 100 per cent mark. Two possible ways of stimulating repairs are open: first, to allow the repairing roads good prices for the work done, and, second, to refuse bad order cars when offered empty in interchange. The former method

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*A paper read before the Car Foremen's Association of Chicago.

rewards a road for doing the right thing, while the latter merely punishes it for doing the wrong thing. Personally, I prefer the former method. I hope the latter one won't need to be resorted to. It congests terminals.

Then there is the car which becomes unserviceable while away from home, due to age and delay, and is not worth repairing. Such car would be torn down by the owner. It should also be torn down by the borrower, as the practice of hauling weakened cars across the continent in order that the tearing down may be done by the owner is dangerous. If the railroads cannot trust each other in the disposal of aged and decayed cars, possibly the Interchange Bureau could serve a useful purpose by examining bad order cars, representing the owner, and authorizing destruction or repairs, according to the merits of the case.

These remarks regarding empty foreign cars relate, as will be noted, to those which have been received under load and have been unloaded and are supposed to be ready for return to the owners.

Now let us touch on the car which is received empty originally, for return loading. Many empty cars are offered in interchange for return loading which are in no shape for the loading. The causes of this are many. The road ordering empties may not have been specific in stating what class of lading was to be furnished; the road receiving the order from its connections may have been specific in telling its local people what kind of lading the cars were to be used for; the mechanical people of the delivering road may not have been advised so they could inspect the cars for the particular lading they were intended for.

A road in ordering empty cars should state what they are for; a road in delivering empties should know what they are for and should see that they are in fit condition. The cars should be selected with specific reference to their fitness and a certificate showing that this has been done should be attached to each car. No bill-of-lading should be issued until the officer issuing it has such a certificate showing that the car containing the lading is suitable to transport it to destination. He should file this certificate for future reference along with the duplicate bill-of-lading.

A little more systematic inspection of empty cars before loading will aid materially in getting them over the road after they have been started on their journey. It will help also to reduce the present expenditure of some twenty-odd million dollars which the railroads of this country pay out annually for lost and damaged goods. This brings us now to the question of delays of loaded cars.

In order to distinguish as between empty and loaded cars, it will be necessary to draw a line indicating when an empty car placed for loading becomes a loaded car and when a loaded car placed for unloading ceases to be a loaded car.

For the purpose in hand, let us say that an empty car placed for loading becomes a loaded car at the first 7:00 a. m. after placement and ceases to be a loaded car at the first 7:00 a. m. after unloading takes place.

The ideally handled loaded car—the 100 per cent car—is one which promptly and safely carries its lading to destination, letting neither the weather in nor the contents out.

Delay may be caused by the shippers through their failure to complete the loading promptly; by the loading road through failure to issue a bill-of-lading promptly; or by failing to promptly pull the car away from the loading track.

Delay in transit may be caused by unfit cars having been selected for the lading, causing break downs and necessitating transfers; by rough handling; by billing becoming lost, or rebilling where no through billing arrangement exists; by the placing of embargoes, and by the practice at interchange points, which happily is rapidly disappearing, whereby interchange inspectors are required to apply so-called defect cards to the bodies of cars covering certain defects, placing the cards in a location where, in order to ascertain what information they contain, it becomes necessary for the inspector to lie down upon his stomach and roll under the car and then all in due time roll out again. So long as the defect card is used, it should at least be in an accessible and uniform location on all cars.

Delay at destination may be caused by the necessity of holding cars for the collection of freight charges where the consignee is not on the credit list; by the re-consigning and inspection priviliges; by failure to promptly place it for unloading and by failure of the consignee to properly remove the contents.

To remedy the transportation shortcomings, it is necessary of course to systematize car handling from starting point to destination, and for all concerned, no matter how many railroads are involved, to work in unison.

To encourage the shipper and consignee to promptly load and unload so that the car may be available for another shipment, it has been suggested that the shipper be rewarded in some way for quick loading; that demurrage be charged on cars held at seaports with export freight; and that the demurrage rate on other traffic, which is at present $1.00 per day after the first forty-eight hours (except on the Pacific slopes where it is $3.00 per day), be increased so that the second day's detention under demurrage shall be, say, $1.25, the third day's detention $1.50, the fourth day $1.75, and so on. Probably something of this kind will have to be done before long. When it is done, let us hope that we shall promptly pull the car away from the consignee's tracks when he has unloaded it, so that he will realize we are really in earnest about trying to improve car performance.

The ideally handled car—the one hundred per cent car, whether home or foreign, loaded or empty, can only result through the combined efforts of the public and of the railroads. Probably we who are in the transportation service can do most toward improving that service, by frankly searching out features which we ourselves can improve, and then by all pulling together, and so do such splendid team work that others seeing the results obtained, will be stimulated to join in the widespread move to make the transportation service of this country 100 per cent perfect.

Discussion.

This paper brought out a very interesting discussion, one of the points emphasized being that the forces and organization of the car department should be held intact the year around and that cars should be put in shape during periods of depression, in order to be ready to meet sudden and heavy demands. Mr. Beardsley, of the Santa Fe, thought that the premium for repairing foreign cars should be increased to 25 per cent or more, making it so high that the owner would have to take care of it and keep it in good condition at all times for all loadings. Also that lading should not be loaded into a car that was not fit to haul it to its destination. Mr. Treptow, of the Lake Shore, brought out the point that car shop facilities have not kept pace with the growth in number and size of cars. Points emphasized by some of the other speakers are as follows:

Mr. Wymer (Belt Ry. of Chicago): There is one thing that strikes me very forcibly and that is the side tracking a habit of retrenchment as soon as the revenues begin to fall off and in this retrenchment they cut down their car force, which is usually the first force to suffer and it results in the cars being side tracked in bad order as is indicated. Now the effect of such condition is very decided as all car foremen, who have had such experiences, know. I personally know of an organization where a good competent set of car men had been employed for several years, and this condition was put into effect and a great many of those men were laid off. After the course of a few months the force was increased on account of some prospects of in-

creased business and as efforts were being made to get the cars repaired, a great many of these men returned for service and took their positions. In about thirty days it was the policy of the road to begin to reduce its force very materially and the men went out and sought other positions and when the time came for increasing the forces again a great many of the men would not surrender the positions that they had secured in other lines of work, fearing that the position would not be permanent and that they would soon experience another reduction. I do not believe that this particular repair point has ever seen the day since that it was able to secure an adequate number of competent car men at times when they were needed. It is an expensive proposition to break up an organization of competent men who have become familiar with the conditions of a certain repair point, and familiar with the cars to be repaired. When it is desired to increase the force, you are breaking in a set of inexperienced men, a great many of them who have never had experience with car repairing before, and it takes considerable time before they become proficient in their work. They cannot accomplish near the results that the old force did and as a result you have a heavy expense without corresponding results. The expenses of the department are greatly increased and you are not able to make the reduction in the bad order cars that you could do with the men who had the necessary experience for the work.

Mr. Wymer: The sentence underscored is this—"The road on whose track the car is located should repair it, and this will be made more practicable than now by standardizing car repair parts." When a railroad company places an order for a portion of your equipment it has an object in view. That object is to put into service equipment to help take care of the transportation of the country and we believe it is the duty of every man who has anything to do with railroads, to put forth every effort to see that that car when it is placed in service, fulfills its mission. In order to do that it would be the duty, from a repairer's standpoint, for the company in whose possession the car becomes bad order, to make it fit for service. By doing so the car in a serviceable condition is not unnecessarily delayed. And then again, if a car is permitted to remain in service in a bad order condition it naturally gets in a worse condition from the result of the defects which already existed. The old saying that "a stitch in time saves nine," is just as applicable to the car upon your railroad tracks as it is to the clothes upon your back. And then again a car which is bad order may cause a serious accident. You all know the results of accidents. They not only damage the car which caused the accident, but in many instances other cars which were in perfect condition are seriously damaged and often destroyed. Not only are cars which are directly involved in the accident delayed, but the entire traffic of a railroad may be delayed for hours. Then a car which is repaired while empty is ready to carry its freight and you all know if they are allowed to remain without repairs they frequently reach points where there is no available car inspector, and agents or others having the loading of cars in charge, load that bad order car unknowingly, and when that car arrives at the end of its journey the load is seriously delayed by repair defects which should have been made while the car was empty. In order to encourage this the thought of having a premium, or rather a fair price for the work placed upon the cars, has been brought out here tonight. We think this is one means of encouraging the repairs of cars. And then again the extension of the rules in some ways has a tendency to bring about this result. Many of you who have charge of repair tracks know that you do not always repair the car perhaps as it should be repaired when it is in your possession, simply because there are certain worn out conditions that would make you responsible on account of combinations, unless you held the car up and took it up with the owners and got authority for making repairs. Now we believe that the M. C. B. rules might be extended some in the way of providing district representatives, if it is not desirable to extend owners' defects, so that there might be some one in authority to pass upon such conditions and permit the road having the car in its possession to repair the car properly and charge the owner for whatever became unserviceable on account of age and decay. It is unfortunate that in many instances men look at the sentiment of the higher officials in solving problems which we meet and hesitate about objecting to practices which may be in effect. They fear that they will incur the displeasure of their officials by taking exceptions to their views. We do not believe that there is any particular danger in doing this, or in fact we believe that most officials and most managers want thinking men. They want men who have ideas and they are perfectly willing to have them expressed.

The sending home of the empty car has many bad results. We are moving a car empty and are burdening our engines with tonnage without any revenue, and if this was summed up into a total it would be surprising in the amount of money expended in hauling empty cars, cars handled in a freight to get them home. Then again cars which are allowed to interchange in this condition are more or less delayed at interchange points. They require a great deal of increased labor on our car inspectors in the way of taking records, issuing defect cards and all of this adds some to the delay of the car.

Now the point of standardizing a car has a great many good features. It assures the car being repaired more promptly as the company which has the car in its possession, has available material. As it is now we are under the delay that is frequently occasioned by having to send to the home road for repair parts, and frequently cars are delayed 30, 60 or 90 days in an effort to get some repair part standard to the car. Then the standardizing of the car also would very largely reduce the amount of material that would be necessary to keep on hand at repair points. It would not only reduce the stock of material on hand but the material could be more promptly secured from the manufacturers. However, there is one feature in regard to standardizing cars which should not be overlooked and that is the effect it might have upon progress. If we standardized a car a few years ago and maintained that standard we would not have the cars that we have today. Some we have today I am sorry to say we should not have, but this is one fact that should be kept in mind in the standardizing of a car. We all aim for progress and each one is making an effort to try to improve upon what we have, but however, the material parts we think could be standardized to a very great advantage among railroads.

President Schultz: The question of handling worn out unserviceable cars has been assigned to me by the Chairman of the Subject Committee. My views on worn out cars, I think, are very well known. I feel that it is entirely wrong to send home a worn out car that will be destroyed by the car owner when it arrives home, and in order to do away with the unnecessary handling of such cars, I feel that M. C. B. Rule 120 should be corrected to read as follows:

"A car unsafe to load on account of general worn out condition, due to age or decay, should be reported to its owners, who must be advised of all existing defects, and upon receipt of such information, he shall authorize the handling line to either re-build the car, or destroy it at owner's expense."

This would either result in the car being destroyed, or re-

paired and put into serviceable condition doing away with the danger of handling such cars in trains, and hauling an empty car in place of a revenue car. In advocating this policy, the question has been raised, that the car owner would have to depend upon the statement of the handling road as to the condition of his car which at all times may not be satisfactory. I feel, however, that this is unwarranted, and especially so at large terminals, inasmuch as there are now in operation throughout the United States, car interchange bureaus, whose employes are unprejudiced, who would make such inspection of any unserviceable cars and report to the car owner. It might be well to go farther. The railroad companies could furnish such bureaus with such data, originally furnished to thetir mechanical officers, as to what amount of money they are expending upon their equipment on the various series of cars owned by them. This would be for the guidance of the Interchange Bureaus, and if this was done, the bureaus could furnish authority immediately, either for repairs, or destruction of the car, in place of first being obliged to communicate with the car owner, and in this way, save a great deal of delay.

I feel that even under present method of operation under M. C. B. Rule 120, that altogether too many home route cards are requested, and the car owners themselves are, as a rule to blame for the cars being hauled a long distance on home route cards, in bad order. Under present M. C. B. rules it is not obligatory on the part of the car owner to furnish home route cards, but he may authorize the handling line to make repairs, or destroy the car, and this I think is the proper thing to do. If this was done, the present practice of asking for home route cards would be very much discouraged, and as I see it, I cannot think of a single reason why worn out cars, (that would be destroyed on their arrival home) should be hauled home empty.

F. A. Pontius, manager of the Chicago Demurrage Bureau, also gave a talk on the delay of cars by the railroads and shippers, giving the viewpoint of the transportation department.

RAILWAY BUSINESS ASSOCIATION.

The annual meeting of the Railway Business Association was held at the Waldorf Astoria Hotel, New York, on December 19. About 900 were present and at the banquet following, speeches were given by James J. Hill, of the Great Northern, and W. L. Mackenzie King, former Canadian Minister of Labor. At the business meeting George A. Post was re-elected president and the following were elected vice presidents: A. M. Kittridge, W. E. Clow, G. W. Simmons, S. P. Bush, A. B. Johnson, H. G. Prout and W. G. Pearce.

Mr. King spoke on "The Canadian Plan for Preventing Strikes." This plan is one which involves compulsory investigation but not compulsory arbitration. Mr. Hill spoke on "The Country's Need of Greater Railway Facilities and Terminals," and in part is as follows:

The commerce of the country can escape disaster only by additions to and enlargements of terminals. Between 1909 and 1910 freight ton mileage grew 11 times as fast as trackage, and five times as fast as equipment. When the railroad yards are filled with cars that cannot be moved, the railroad loses a portion of its earnings; but the business man loses a larger share of his trade, and the workingman his employment.

The public assumes that if enough cars are provided they can be moved on schedule time from point of origin to destination, wherever these may be. This is not the real trouble. What is really needed is the greater movement of cars. There is but one possible remedy—enlarged terminals.

The main question back of that is financial. Large sums of money must be raised. What security can the railroads offer? Many of them have not only pledged their credit to the limit but have absorbed a large share of their surplus earnings that in other countries would have been paid out in dividends. Gross revenues grow, but expense grows faster. During the first seven months of 1912 operating revenues increased 3.3 per cent per mile as compared with the same period in 1911; operating expenses increased 4.9 per cent, and net operating revenue decreased .5 per cent. The addition to taxes and other incidental expenses will raise this figure.

Ten or 15 years ago 4 per cent would bring in capital for railroad improvements. The rate has advanced from 1½ to 2 per cent in little more than 10 years. The railroads can pay money only as they are permitted to earn it. It is up to the people to say whether or not these terminals and other facilities shall be supplied; just as it is up to them to suffer the severest of the consequences if they are not.

The railways are entitled to confidence and relief because they have displayed efficiency. The figures show an increase of traffic in a year about five times as great as the increase of equipment and 11 times the increase of mileage. Yet the machine has been hauling its load because efficiency has been developed. Heavier rails, larger engines, cars of greater capacity, increased train movement and the full utilization of equipment have kept business moving. The density of traffic in England, France and Germany should be as much greater than in the United States as the density in the Middle exceeds that in the far Western States. Yet the ton miles per mile of road are: France, 496,939; United Kingdom, 529,622; Germany, 827,400; United States (1910), 1,071,086.

They have shared their gains liberally with the people through rate reductions. It has become common to think of the progressive lowering of rates, while all other charges are rising, as the work of legislative compulsion. On the contrary, many of the most important reductions made in the past were voluntary. If railroad rates in the United States had increased as much in proportion as the prices of commodities and the wages of labor between 1894 and 1909, the country's bill for transportation for those 15 years would have been over seven billion dollars more than it was.

If they are to furnish the necessary additions and provide new terminals, without which the traffic of the country can no more continue to move than a derelict can voyage from port to port, the money will not come, as a magician catches coins, out of the air. It must be either earned or borrowed.

The railroads should be permitted to earn and hold a surplus equal to 50 per cent of the amount they pay out in dividends, to be held for emergencies and applied to improved facilities.

The country cannot rise to the level of its duty or its opportunity until the scientific knowledge of the expert and the action of the just judge are applied to the settlement of economic issues. The American people must soon begin to realize how injuriously they are themselves affected by a game that has been played for so many years with their business prosperity and their future welfare. The people must realize that regulation must not be strangulation.

It is the duty of every business organization, of every business man, of capital interested in safe investment and labor interested in sure and remunerative employment, to help swing the country into line behind the only policy that can help and save them all. No pledge of national credit, no subsidy in cash, no immunity or privilege is asked; only freedom to raise on reasonable terms the capital without which the work cannot be done; implying necessarily freedom to earn on that capital the return without which it will not be forthcoming, and enough additional to make and keep railway equipment and service equal to the progress of invention and improvement and to the just expectations of the people.

DRAKE GAS-ELECTRIC CAR.

A new type of passenger motor car has been introduced into this country during the past few months and is now in service on the lines of the Missouri, Oklahoma & Gulf Ry. The essential feature of the car is its power plant, which is the combination of a gasoline engine with a generator and motors, and while the car is new in this country, it has been in successful use for a number of years on the continent in Europe. It is called the "Dracar" and is supplied by the Drake Railway Automotrice Co. of Chicago. Its designer, Francis E. Drake, had a long experience in developing automobile motors previous to taking up motor car work. The car has been very successful on the lines of the Arad-Csanad Railway in Hungary, where it has been in use since 1903 and where the number of train miles with motor car service has increased from 67,017 in 1903 to 952,143 in 1911. The profits per train mile have increased during the same period from .0843 cents to .1732 cents.

placed in a rectangular shape on the roof of the car and extending practically its entire length, in cold weather the jacket water being used for heating the car. In the baggage room is a Peter Smith heater, which is connected to both the radiator and the coils in the car, thus enabling the water to be kept from freezing when the engine is not running. Two thirty-gallon tanks are placed overhead, one on each side, in the engine room, and the fuel is fed by gravity. The trucks are M. C. B. standard and are also furnished by the St. Louis Car Co. The total weight of the car is 65,000 pounds.

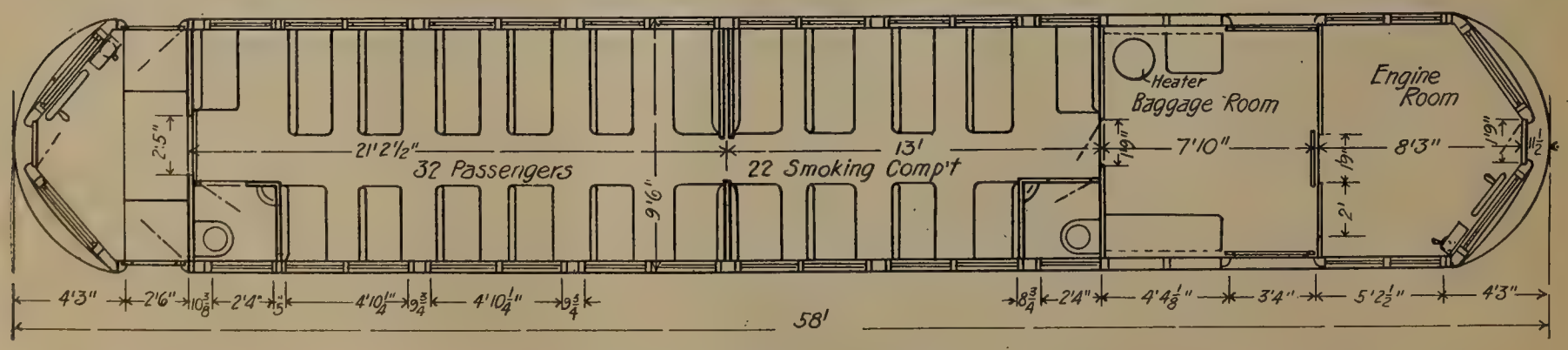
The engine used in the cars is in reality a high-grade automobile engine and at present is being imported from France, although it is expected that it will be manufactured in this country later. It has six cylinders cast in pairs, each cylinder measuring 140x160 millimeters. It develops 90 horsepower at 950 revolutions and is directly connected to a 55 kilowatt 500-600 volt interpole generator, both being mounted on the same base. The

Gasoline-Electric Motor Car for the Missouri, Oklahoma & Gulf Ry.

The cars used on the lines of the Missouri, Oklahoma & Gulf Ry. have a total length over bumpers of 56 feet and a width of 9½ feet. The car bodies were built at the plant of the St. Louis Car Co. and are of wood with steel and wood underframes. The power plant is located in the front compartment and immediately back of it is the baggage compartment. In the passenger compartment individual chairs are provided, and as the cars have to be operated as "Jim Crow" cars, a suitable partition is provided to mark the color line. The seating capacity is thirty first-class and fourteen colored, toilet rooms being provided in each section. The cars have turtle roofs, with ventilators set flush, are provided with continuous package racks and are finished in mahogany. Lighting is by storage battery. The radiator for the engine jacket water is composed of pipes

engine and generator are placed across the car, requiring only 7 feet and 3 inches of the car's length. The latest cars, however, are being made with a more pointed end, which provides a foot of additional space at either end.

The carburetor used is of special design, and by a slight adjustment can be made to handle gasoline, kerosene or naphtha with equal facility. The change from one fuel to another does not affect the engine in the least, and on some of the cars in use in Europe two or three different fuels are used on one run. The average consumption of gasoline of the European cars is a gallon to a four-mile run. The usual airbrake valves, hand brakes and controller are placed in the engine cab. On the controller handle is placed a small wheel for also controlling the engine. The motors



Plan of Latest Type of "Dracar."

End View of "Dracar" Showing Portion of Engine.

have a constant rate of acceleration, and the load is balanced at any speed, so that there is none of the jerking effect, the car starting gently and without strain on the car frame. The motors are Westinghouse number 305 interpole type and the car is geared for 35 miles an hour. Higher speeds could be provided, but a speed of 35 miles per is entirely sufficient for all branch-line service. A very important feature of the car is that the rear platform is provided with a duplicate set of controlling devices, so that the car can be operated from either end. This makes the car all the more adaptable for branch-line service where turntables and wyes are infrequent.

The Missouri, Oklahoma & Gulf Ry. is a road over 200 miles in length, extending from Wagoner, Okla., to Sherman, Tex., and it will have six "Dracars" in operation in the near future. These are to operate as follows: Two between Muskogee and Dustin, two between Durant and Dennison and two between Wagoner and Joplin. Four are now in operation. They are providing service additional to the regular train service, and it is expected that the traffic of the road will be greatly developed. The schedules vary from two hours and a quarter to one hour.

The fourth car was recently completed at the plant of the St. Louis Car Co., and on December 14th was run up to Chicago where it was on exhibition during the afternoon at the Depot of the Chicago Great Western R. R. It was here inspected by a number of mechanical officials and was then sent to Oelwein, Ia., going from there back to St. Louis. On the run from St. Louis to Chicago, the car averaged two and one-half miles per gallon of gasoline. The cars in service, however, average three miles per gallon or better, for the day's consumption.

In general it might be said that motor car service is more highly developed in Europe than it is here. The field of the passenger motor car is almost exclusively in branch-line service, and this field offers great development in this country.

Marvin F. Wood, general sales manager of the Van Nest Co., New York city, has resigned.

FUTURE OF LOCOMOTIVE CONSTRUCTION.*

(By Leopold Kliment)

(Continued from the December issue)

As against these advantages, there are the following serious disadvantages: First, the greater cost of the permanent way, due to the cost of the conductor; second, greater capital outlay, as the electric locomotive plus its fraction of the central power station must cost much more than the steam locomotive with its shed. It may be mentioned that the sheds for the steam locomotives are often very modest, and also that the spares can certainly not be fewer in the case of electric operation, as the increase in the number of different parts increases the possibility of trouble. It was taken into consideration that one central-power station is to serve many electric locomotives, and hence I mentioned the fraction of the central power station.

It is easy to see that the capital outlay has to be considerably larger; I will now cast a glance at the working expenses.

If it is possible to build the central power station near a coal mine, the cost of transporting the coal is eliminated and it is possible to use fuel of poorer quality. But it will be difficult to realize everywhere such an ideal state of affairs. In all other cases, the coal must be brought to the central power station, and here again it is only a question of difference. If the arrangement I have spoken of really existed, it would at once be recognized that not less, but more coal would have to be burnt at the central power station, because there must always be losses in converting mechanical into electric energy and then converting it back again; there must also be losses in the conductor. Likewise there is no saving in staff, although the electric locomotive may be driven by one single man, for at the central station, stokers, engineers and switchboard attendants are required. In the case of smaller installations the staff has to be increased. In large installations each man at the central station can do more, but even if mechanical and electric devices are pro-

*Bulletin of the International Railway Congress.

Interior View of M. O. & G. Motor Car.

vided, it will hardly be possible to have fewer men than when steam locomotives are used. If the Austrian State Railways were to be electrified and steam power used at the central stations, there would be a saving in firemen, but at least as many electricians would be required for the central station and for looking after the conducting line. It must also not be forgotten that the presence of two men on the steam locomotive forms in a certain way a reserve, which increases the safety of working. Will one single man on an electric locomotive always suffice?

Accordingly, in the arrangement assumed, the introduction of electric operation would materially increase the working expenses. I will now proceed to show, in this arrangement, how and where working expense can be saved, how accordingly the increase which we have so far observed in capital outlay and in working expenses can be counterbalanced.

The reason why it is possible to make electric operation economic is based on reasons of a thermo-dynamic character. In the early days of steam-engine construction, stationary steam engines and steam locomotives were designed on exactly the same principles. As, however, their designs were less hampered, the stationary engines became developed much more quickly and the fuel used with them is much better utilized than is the case on the steam locomotive; so that, although they started equal, there has been a continually-growing difference between the fuel-consumption of stationary steam engines and of steam locomotives. Now, it is this difference in the fuel consumption which makes it possible to counterbalance, more or less, the greater expense undoubtedly incurred by the introduction of electric operation. It may, however, at once be mentioned that this difference would again become reduced if the fuel consumption of the steam locomotive were reduced; that is to say, if it approximated to that of its near relation, the stationary steam engine. The objection might perhaps be raised that in the same time the stationary engine would also be improved. Without wishing to deny this, I can answer that here, as in all other cases, there are limits, and that the nearer one approaches those limits, the more difficult does improvement become. Now the stationary engine is much nearer those limits.

To begin with, I will show what causes the saving in fuel, if the steam locomotive actuating the dynamo is replaced by a stationary steam plant of the most modern character.

The better utilization of the heat is effected:

(a) In the steam generators;

(b) In the steam engine.

As regards the steam generators, the following remarks may be made:

As a stationary boiler house is not limited for room, the smoke gases can be cooled more effectively by increasing the heating surface and using water heaters, so that less heat is lost up the chimney. The loss of heat by conduction and radiation is also less with a stationary boiler than with a locomotive boiler. Although the locomotive boiler is more expensive on account of its design, and of the copper and metal used, in the case of the stationary boiler we have to add the necessary increase in the heating surface, the feed-water heaters, the brickwork and the chimney, referred of course to the same amount of power. It may be remarked that superheaters are used now not only in stationary plants but also on locomotives, and although superheaters are not at present in general use on locomotives because it is necessary to continue to use the old locomotives, yet we can only compare new steam plants with new steam locomotives. The advantages of superheating will be considered later on in connection with the steam engine.

The grates can be fed in the case of stationary plants by mechanical devices (automatic stokers and automatic supply of coal).

In this way the combustion is improved, no smoke being produced. It is also possible to use fuel of a poorer quality and a saving is effected in the labor required for stoking, as per man a greater quantity of steam is generated. This saving in labor is, however, reduced by the cost of the staff required for the maintenance of the mechanical devices. In any case there is a saving of staff, which may be utilized to counterbalance, in part, the additional staff required by the electric plant. We must, however, not forget that mechanical stoking involves expense, and that this partly counterbalances the saving in the coal consumption resulting from the more complete combustion.

As regards steam engines, it may be remarked that these consume less steam if the degree of expansion is increased, if accurate valve gear and condensers are introduced, and if high-pressure superheated steam is used.

The steam locomotive has always been using high-pressure steam, and of late superheat is also used with success. Similarly, higher degrees of expansion are possible in the case of compound locomotives running long distances; on the other hand, condensation of steam as employed in the case of stationary engines is impossible, and this is a very important factor, the stationary steam engine works with condensation, the steam locomotive without. This represents an important saving thermo-dynamically, and this shows itself in a saving of fuel. It is true that the condensation plant also involves capital outlay, just like the other measures for reducing the coal consumption, but the saving in coal is so great in this case that a material economy results. This is more particularly true if natural cooling water is available in sufficient quantity.

The different points described apply not only to the reciprocating steam engine, but also just as much to steam turbines, which alone are now used for such central power stations.

Thermo-dynamically the steam turbine is at least the equal of the reciprocating steam engine, but it makes it possible to have smaller engine-houses; moreover, it has the advantage of revolving at a high speed, and this enables a smaller dynamo to be used, which costs less. The saving in oil is also one of the features of steam turbines. It is also of importance that in the steam turbine the rodding of the reciprocating steam engine is eliminated. I must not forget to mention that the advantages of condensation are even greater in the case of the steam turbine than in that of the reciprocaing steam engine.

By increasing the capital outlay we can, as I have shown, improve the heat utilization, and as the steam turbine requires a smaller capital outlay, it is intelligible that the coal saving in a stationary plant, as compared with the steam locomotive, is of great importance and makes it possible not only to pay for the interest and amortization of the different fuel-saving appliances used, but even to leave a surplus.

But this surplus must suffice to cover the purchase and the maintenance of the whole electric plant, the dynamos, the switch-board, the condensing lines and the electric locomotives; moreover, it must suffice for covering the losses involved in converting the mechanical energy of the steam turbines into electric energy, in conducting that energy a distance and then converting it back again into mechanical energy on the electric locomotive. One must then admit that this can only be possible under specially favorable conditions, and not generally; the question can only be decided on the basis of the special figures concerned, which vary in each individual case. The higher the price of coal, the easier does economic electrification become; the smaller the coal consumption of the locomotive, the more difficult does it become.

Would many railway administrations not work more prof-

itably if they replaced their old locomotives by new and better ones? I may remark that such a change is very difficult, for after all the old locomotives can do the work. But there is one way of getting rid of the old coal devourers and the double heading, and that would be electrification!

It is clear that the electrification of railways is only economically possible if the stationary steam plant works so economically that the electric plant can be paid for out of the coal saving, and have also explained that the smaller the coal consumption of a steam locomotive, the more likely is it to remain the prevailing type.

I will next proceed to consider how the coal consumption can be reduced, and I will take the same train of thought as in the case of the stationary plan.

As regards the steam generator, I may remark:

High pressures of steam were always usual on locomotives, and they are hardly likely to become materially increased, even if the water-tube boiler is more generally used. Steam superheating on locomotives was successfully introduced by Wilhelm Schmidt, so that a general application of superheat appears probable; at present many locomotives are already equipped with superheaters. Recently attempts are also being made to use the smoke gases for pre-heating purposes, so as to reduce the temperature of the smoke gases still further, by increasing the heating surface.

As regards the automatic stoking, that is not so easily carried out in the case of the moving locomotive burning coal; the coal can, however, be conveyed to the locomotive mechanically just as in the case of a stationary boiler. On the other hand, automatic stoking is easy if the coal is replaced by crude oil, naphtha or similar bodies. The liquid fuels have a high calorific value, giving 10,000 to 11,000 heat units as compared with the 6,000 to 7,000 given by coal; accordingly, the cost of transport is less and the fuel is very readily conveyed in pipe lines. At present, the Austrian State Railways already have several hundred oil-fired locomotives in use. Such locomotives are used in Galicia and on the Alpine lines. Although most locomotives which now have oil firing have it in addition to coal firing, and only use the former on the steepest lines and in tunnels, because the combustion gives no trouble and no smoke, and is also more economic, yet it is logical that locomotives should have the first claim to crude oil for firing, and that such oil should be reserved for them, with quite as much right as it is proposed to give railways the first claim on water-powers. It is right economically, both from the point of view of the country and of the world generally, that every article should be used there where it is most suitable. It would be wrong to use the coal waste of coal pits on locomotives and the crude oil in stationary power stations. Crude-oil firing, where crude oil is available, gives better efficiencies without taking any special measures. The difference of price between crude oil and the other fuels naturally exercises a great influence on the economy of the working.

As regards the engine proper of the locomotive, we may make the following remarks:

The advantages of high pressures, of superheating and of better expansion now seem fully utilized both in the case of the newer steam locomotives (compounds) and in that of stationary steam engines. On the other hand, the valve gear has remained practically unchanged, the only difference being that piston valves are used generally in consequence of the superheating of the steam. In this case, also, there is a further development possible, such as has already begun in many places in Germany. I mean the introduction of Lenz valve gear. I do not know of any applications of it in Austria, but the example of stationary steam engines as well as the simplicity of this gear makes me confident that the difficulties of introducing poppet valve gear on the locomotive can be and will be overcome, particularly if I consider the points mentioned below:

It has already been noted that higher degrees of expansion have been obtained by the use of several cylinders, both in the case of stationary steam engines and in that of steam locomotives. Quite recently, however, Professor Stumpf has shown, for the first time, by means of a stationary steam engine built here in Brunn by the Erste Brünner Maschinenfabrik, that the advantages of the two-cylinder compound can be obtained by means of a single cylinder, which it is true is approximately twice as long, by the use of exhaust slots. The use of the parallel-flow principle, the Stumpf principle, on locomobiles has also been tried by the firm in question and at the Brussels exhibition, besides a locomotive with Lenz valve gear constructed by the Hannoversche Maschinenbau Company (formerly Messrs. Egestorff), there was also shown a parallel-flow locomotive on the Stumpf principle, built by the Vulkan Company of Stettin. A great advantage of this design is that the cylinder only has two valves, and this results in a material simplification. The exhaust is provided for by the piston itself, by means of the exhaust slots. The latter are not patented in Austria; on the other hand, Professor Stumpf has taken out a patent, in which he provides, in a simple way, for the exhaust by a piston valve, so as to avoid the high compressions which arise in stationary engines of Stumpf design, and the long cylinders in the case of locomotives. High compressions are to be avoided in the case of the locomotive, as this is an engine with exhaust, and large clearances reduce the economy.

In the case of stationary engines, I arrived at the conclusion that a material saving may be effected by the condensation of the steam. This saving is particularly great if natural cooling water is available. As condensation is impracticable on the locomotive, the latter can under the most favorable conditions only be compared with the stationary engine within the limits set by the condensation.

In America it is intended to place an air compressor before the locomotive cylinder, in order to mix compressed air heated still further by the hot gases, with the steam. It is more than twenty years ago now that Wilhelm Schmidt made experiments in the A. Borsig Works in Berlin with mixtures of air and steam, it is true for other purposes, but without success. The air abstracts heat from the steam during expansion, and hence I cannot think that condensation in the stationary engine can be replaced in this way on the locomotive. Further experiments are required to elucidate this matter.

Even if all the improvements made do not succeed in making the steam locomotive as good a machine, thermodynamically speaking, as the stationary steam engine, it must be remembered that out of this difference it is necessary to defray the cost of the whole electric installation, allowing for the losses of current.

As the saving which experience shows can be effected by condensation may be expressed as a percentage, then applying this percentage to the actual coal consumption of the best locomotives, as determined by the administrations, we obtain the amount, it is true only approximately (but the method is correct in principle), which would be available for interest and amortization of the capital to be expended on the complete electric plant (dynamos, conductors and electric locomotives), and also for covering the losses of current. The cost of the steam plant at the central power stations is excluded in this case, because the corresponding capital would be spent in acquiring the best locomotives, so as to be able to compare best steam locomotives with best steam plant at the central power station. I have expressly noted that the difference due to the condensation represents a minimum which is not quite attainable. Probably the actual differ-

ence will be a little larger, and the locomotive boiler will hardly equal the stationary boiler; but I have also left out of consideration any profits, which should not be missing in the case of such a big undertaking. The possible sale price of the old steam locomotives could also, and justly, be placed to the credit of the profits accounts. A railway administration which already possessed the best locomotives would have to take into account the total actual coal consumption of the steam locomotives, but, on the other hand, would have to add the cost of the stationary steam plant to that of the electric plant.

The objection could be raised that steam locomotives often have to be in reserve and stand idle; but it is also necessary to have available reserves at the central power station, and here also it will not be possible to avoid running light or under reduced load. These are again differences, against which there always are a considerable capital outlay and considerable losses, as the whole conducting system must always be kept supplied with the current.

The steam engine was the first useful heat motor and has remained paramount to this day. The steam locomotive represents the adaptation of the steam engine to purposes of transport. A sister of the steam engine in the family of the heat motors is the internal-combustion motor, and for purposes of land carriage only the oil engine or the Diesel motor can be considered. It has already been mentioned that mineral oil is used for firing steam locomotives; the process can, however, be simplified by not producing steam, but by burning the oil direct in the cylinder and converting the heat into mechanical energy. A better thermo-dynamic efficiency is obtained in this way than if the roundabout process of steam production is adopted. In this way we even succeed in entirely eliminating condensation, which we have missed so much. On a smaller scale, we now have such engines in road motor cars, but the system adopted on such cars is not suitable for larger units. The Diesel motor and the oil engine have, from the point of view of locomotive working, the serious disadvantage that they cannot start under load. It does not seem impossible to eliminate this disadvantage, and the brothers Sulzer of Winterthur have taken out a patent, under which compressed air is used for starting. The internal combustion motor only begins to work after the train has started. The compressed air is produced by a small Diesel motor which drives a compressor. A locomotive is now being built under this patent.

If the road motor van is destined to replace minor railways, it will be a step in advance to reserve crude oil for standard-gauge locomotive traffic, particularly if the difference of price between crude oil and coal makes economic working possible.

Until now I have only considered matters from the economic point of view; but I do not wish to lack thoroughness, and hence must add that the saving in coal is not always the decisive point, but that other factors also come into play. Thus, for instance, electric working is preferred for urban railways, even if more expensive. A frequent train service, and stops short distances apart, have a bad influence on steam traction and its economy. The electric motor car is very suitable for this purpose, also for sharp curves on streets and roads. The nuisance of smoke and dust is nearly entirely eliminated and on underground railways steam traction is very inadvisable. Those preceding considerations make it evident why the Vienna Stadtbahn has not yet been electrified. The working could not become cheaper, even if the line had been built for electric operation from the beginning. But it would be much more difficult to cover the great cost of the conversion. Such calculations are very easily given a favorable turn by introducing unknown quantities. It is, for instance, asserted that the traffic on the Vienna Stadtbahn would greatly increase after electrification. But that is an unknown quantity, and I do not think that the steam locomotive really prevents so many people from using the Vienna Stadtbahn; indeed, this is confirmed by the instance of Berlin. The smallness of the traffic is also due to other causes, for instance the route the line takes, etc.

The extension of the network of the Stadtbahn, which involves a second unknown, would only cause the cost of electric working to be reduced in a secondary way. A proof of the correctness of this opinion is that in spite of experiments made on the larger scale, no steps have as yet been taken to electrify the Vienna Stadtbahn, and in this case electric operation would be advisable quite apart from the cost of working. What applies to the Stadtbahn also justly applies to the mountain lines, and here the lifting work the coal has to do is a factor unfavorable to the steam engine. Hence the steam rack locomotive will become rarer and rarer, and it will disappear in those mountain districts where water-powers can be utilized.

As I have given reasons in favor of electric operation quite apart from economy, so will I also give such in favor of operation by steam and oil locomotives. The steam and oil locomotives are primary machines and can be directly compared with each other. They have all the advantages which a primary machine can have, in consequence of its independence. This becomes of considerable importance, if we consider the use of railways for military purposes. The enemy is able to stop the whole traffic by destroying the conductors, by attacking the central power station.

At present it is the object of the enemy to destroy the railway at sundry places. In future he would only aim at the conductors and at the central power stations; he would, on the contrary, have an interest in preserving the railway proper, so that he could use his own steam locomotives on it. Accordingly it would be necessary for the State, even after electrification, to keep steam locomotives for military purposes.

I have tried to look at the question from every point of view. In particular, I think I have proved that the steam locomotive has by no means reached its possible limit of development, and that it will not be put out of existence by the electric locomotive; on the contrary, it can leave to the latter its own wide field of application.

The electric motor is to be preferred in all cases where water-powers can be utilized economically, where smoke has to be avoided for hygienic reasons, where small loads have to be hauled in quick succession, or greater loads have to be hauled with frequent stops, and where it is a question of utilizing poor fuel or even waste products. For a long time to come, it will remain the task of the steam locomotive to haul heavy trains long distances in level countries, to work the traffic in countries poor in water-powers but rich in good fuels. Perhaps it will be replaced in some of its applications by its sister, the locomotive with an oil engine, but even in this case not wholly, for the steam locomotive is not so particular as to the fuel it requires, and can also work, as for instance in Russia and other countries where timber is plentiful, with wood as fuel. And so I conclude with the wish that the steam locomotive, to which we are indebted for a great part of our civilization, may continue also to do us good service in the future!

A SUM equal to 2 per cent of the entire amount of wages paid each employee during 1912 is to be paid to the employees of the L. S. Starrett Co. of Athol, Mass., during January. The circular announcing this fact says, "We want men, not human machines; not time alone, but brains. A man who is worth twenty dollars a week takes up no more room than one who is worth hardly ten. We are glad to repay increased efficiency by increased wages."

Electric Locomotive, Spokane & Inland Empire R. R.

A 50-ton standard gauge Baldwin-Westinghouse electric locomotive, suitable for yard service, has recently been furnished the Spokane & Inland Empire Railroad for use in the Spokane yards.

Four Westinghouse No. 301-D-2 motors are geared with a ratio of 17:60 to 37½ inch wheels. The nominal rating of the motor is 100 h. p. at 600 volts and 150 amperes. The 301-D-3 motor is a box frame commutating pole machine. The motors are permanently connected two in parallel, the groups being connected in series and parallel with each other in conjunction with the necessary resistance to produce smooth acceleration. Westinghouse HL electro-pneumatic control, which, because of its heavy contact pressures and positive action, is particularly adapted for handling the heavy currents encountered in locomotive operation is used.

A double and E. L. type automatic brake equipment is employed and air for the braking and control systems supplied by two D-3 motor-driven compressors, each having a displacement capacity of approximately 35 cu. ft. of free air per minute. A hand brake is provided for holding the engine when it is stored up in yards.

The locomotive is designed to traverse curves of 34 feet radius when running without a trailing load. The trucks are of the equalized pedestal type, with square frames forged in one piece and rigid bolsters of cast steel. The pedestals are provided with removable shoes, which can easily be replaced when worn. The axles are of forged steel, and the wheels are steel tired with cast steel spoke centers. The tires are held by bolting fastenings.

The longitudinal frame sills are four in number, consisting of 12-inch channels. Strong diagonal bracing, consisting of 1½x6 inch bar iron, is used on each side of the bar frame between the middle and outside channels. The end bumpers are of cast iron. The frame bolsters, which carry the truck center pins, are 1½x15 inches in section and are braced by flanged plates, which are riveted to them and also to the longitudinal sills. A long switching step is bolted to each bumper. The couplers are of the M. C. B. automatic type, with slotted knuckles, and their centers are 34½ inches above the rail.

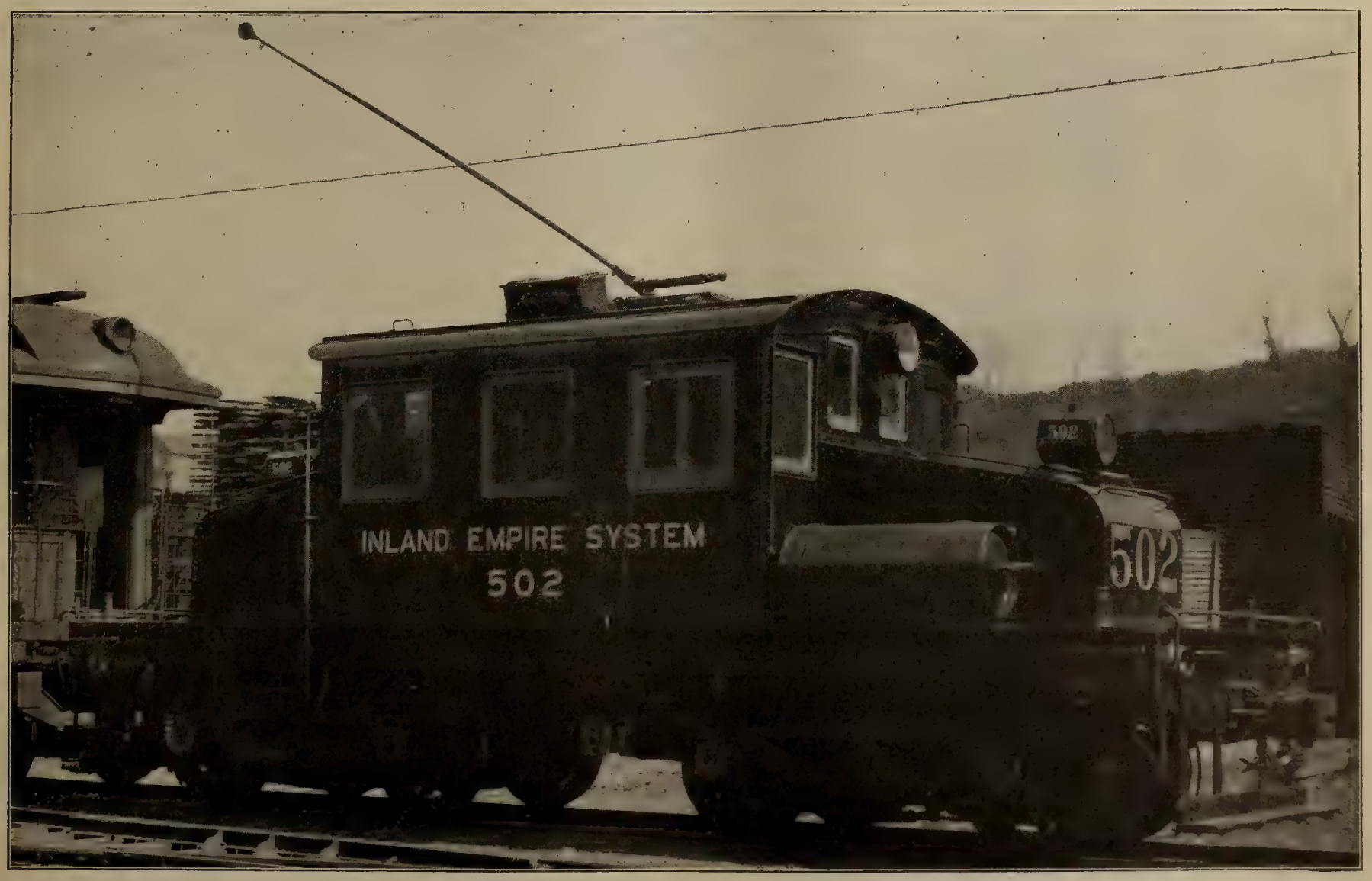
The cab is of steel and centrally located. It has a length of 12 feet and a width of 9 feet 3 inches and may be entered from either end. Large window openings give an unobstructed view in any direction. Controlling equipment is installed in duplicate, the locomotive being arranged for double end operation. As is usual in a locomotive of this type, a sloping hood is placed at each end of the cab, and these can easily be opened to allow access to the equipment which they cover. The locomotive is furnished with one bell, two air whistles and sand boxes at each end with pneumatic sanders.

The principal dimensions are as follows:

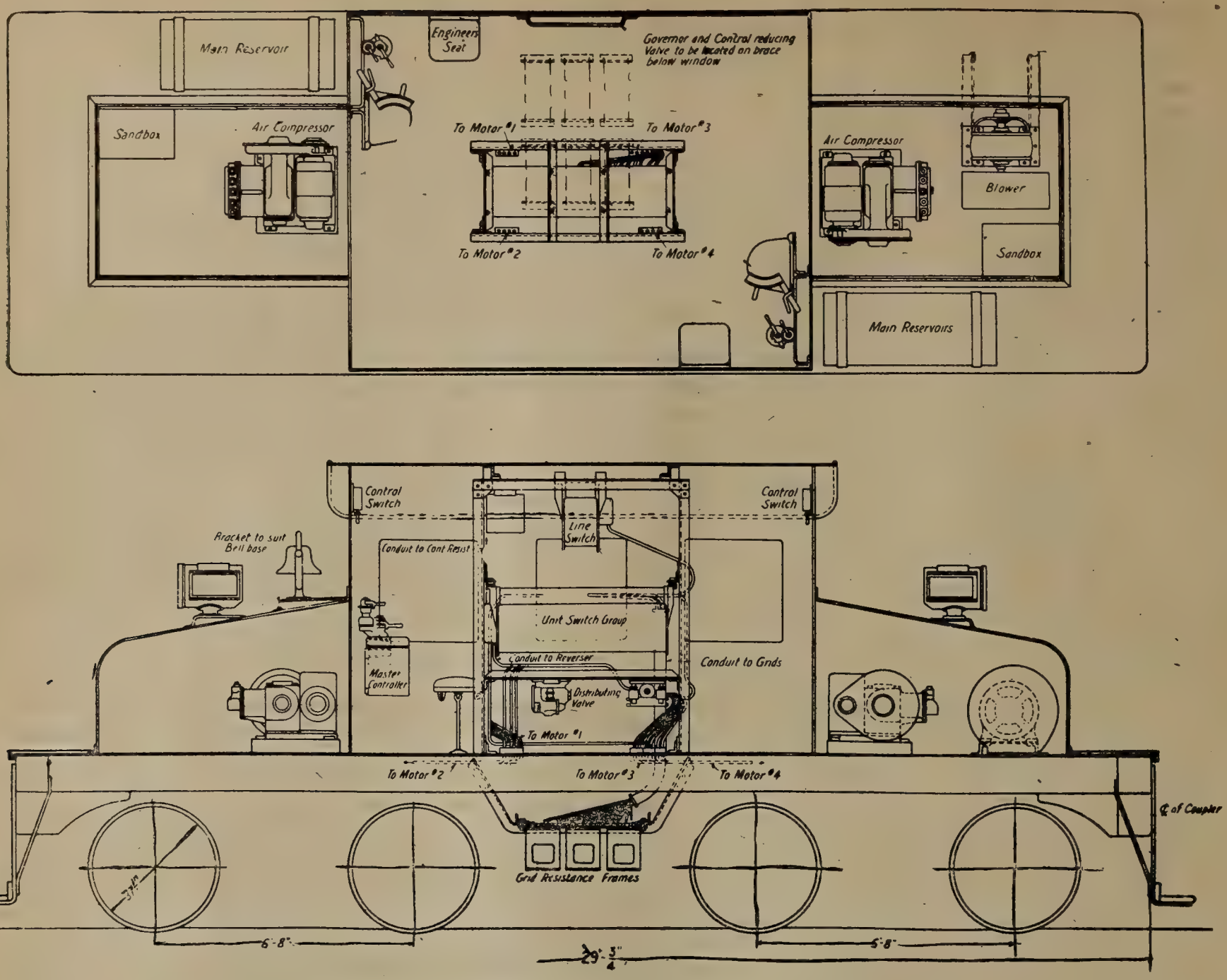
Width, 9′ 6″.
Height to top of cab, 12′ 1″.
Length between coupler knuckles, 32′ 2″.
Wheel-base, rigid, 6′ 8″; total, 22′ 2″.
Distance between truck centers, 15′ 6″.
Driving wheels, diameter outside, 37½″; center, 31″.
Journals, 5′x9″.
Weight, 100,000 pounds.

The equipment layout shown in the illustration gives the location of the control switch, master controller, line switch, reverser, switch group and control resistance. This locomotive being the steeple type cab, has practically all the control equipment located in the central part of the cab.

The heavier parts of the control equipment, namely; the switch group, line switch and reverser, are mounted on a steel angle iron frame which is fastened to the floor of the cab, and also to the roof of the cab.



Spokane & Inland Empire Locomotive.



Diagrammatic Sketch of Inland Empire Locomotive.

One air compressor is mounted under one of the hoods of the cab, and under the other hood of the cab is mounted a second air compressor and blower. This motor-driven blower supplies air for ventilating the traction motors. As may be noted, this locomotive is arranged for double-end operation, having an operating equipment consisting of a master controller and engineer's valve located at opposite corners of the cab.

End View, Spokane & Inland Empire Locomotive.

The motors and auxiliary apparatus have sufficient capacity to enable the locomotive to exert continuously a tractive effort of 9,400 pounds with 600 volts at the motors, with average wheel diameter of 36". It will also exert a tractive effort of 16,000 pounds at approximately 9.2 miles per hour with 600 volts at the motors. With clear dry rails it will be able to exert momentarily a maximum tractive effort of 25,000 pounds.

PULLING THE FIRST SPIKE preparatory to taking up the tracks of the Chicago, Rock Island & Pacific through the court house square at Joliet, Ill., was done with considerable ceremony. The tracks had for years made the park surrounding the court house unsightly and unsafe, but with the recent track elevation work and the building of a Union Depot at this place, the necessity for these tracks was done away with. Capt. James G. Elwood, son of Nelson D. Elwood, secretary of the first board of directors of the Rock Island & La Salle Railway, pulled the first spike.

* * *

SHIPPERS and receivers of freight to the number of 4,000 have declared in favor of a policy of permitting the railways adequate revenue to meet existing obligations. The names of these shippers were recently published in a pamphlet issued by the Railway Business Association and are scattered throughout nearly every state in the Union.

* * *

ROD TRANSMISSION IN ELECTRIC LOCOMOTIVES.*

By G. L'Hoest.

Some years ago coupling rods were introduced into the design of electric locomotives, these rods being used to couple together axles the adherence of which was to be utilized. This made it unnecessary to divide the motor apparatus into as many separate units as there were axles to drive. This adaptation of a device which has become classic in the case of the steam locomotive, to the electric locomotive, was at first considered an indisputable step in advance, but of late this has been considered doubtful. In some very recent electric locomotives, this system has even been given up and spur gearing, which it had displaced, has again been adopted.

In fact, when designing electric locomotives, one has to choose between several designs. This does not exist in the case of steam locomotives, since the attempts made at different times to replace their coupling rods by better appliances, did not meet with any success. Under these conditions, it seemed to us of interest to make a careful examination of the working of coupling rods, and that is the object of the present paper.

Let us consider two sets of wheels of the same diameter, coupled together by means of identical crank pins and by coupling rods whose length, measured from center to center of the ends, is precisely equal to the distance between the centers of the axles. If one of these sets, which we will call the driving set, transmits a couple to the other, it is evident that the angles of the cranks must differ, the difference depending on the compression or tension acting on the rods; for we cannot conceive the transmission of any force by an elastic medium without elastic deformation of that medium.

The angle represented by this difference could easily be calculated, as a function of the couple transmitted, if we could leave out of consideration certain points in the construction, such as the necessary play in the bearings, as well as unavoidable inaccuracies in the work; in particular the inequalities in the diameter of the wheels, in the lengths of the rods and even of the radii of the cranks. But the problem becomes very complicated if we wish to allow for all these factors, assigning to each an independent value so as to leave the problem quite general.

Our object being only to set forth the main principle of the actual and real working of coupling rods, we feel justified in making certain assumptions which will enable us to simplify the equations.

We will first of all assume that the play between the crank pins and the bearings of the corresponding rod ends is the same at the four articulations of the system of two rods which we are considering.

We will next assume that the excess length of the rods, that is the amount by which they are made longer (excess equal to the difference between the distance between the center of the bearings and between the center of the axles) is the same on the left side as on the right side. Sometimes, during construction, such excess length is provided in order to make up for the expansion of the frame plates which are near the boilers; in the case of electric locomotives, where such expansion is not to be considered, any excess length can be due only to wrong design or to faulty adjustment of the bearings.

The diameters of the wheels are never absolutely equal, but the only appreciable errors are always observed between two sets of wheels and not between the two wheels of one given set. Hence, we will consider the diameters of one set as absolutely equal, inequalities existing only between the wheels of two different sets. In practice, the magnitude of these differences amounts to some tenths of a millimetre, when the tires have just been trued; during use they may become a little larger, owing to unequal fatigue and to differences in the metal used for the tires.

Modern construction is sufficiently accurate to enable us to leave out of consideration other defects, such as inequalities in the throw of the cranks, inaccuracies in their adjustment, the bending of the cranks and of the crank pins; it would, moreover, be difficult to eliminate them.

To sum up, we will only consider the inequalities in the length of the rods, the inequalities in the diameters of wheels fixed to different axles, and the play existing in the articulations of the rods and cranks.

Let us take:

L =the true length of the rod, when no stress is acting on it, measured from center to center to the bearings at the two ends;

l =the distance between the centers of the axles which are coupled together by the rods, according to the designs;

λ =the distance, at a given moment, between the centers of the crank pins coupled together by one given rod;

a =the play between the crank pins and the corresponding coupling-rod bearings; we assume that a is the same for all the crank pins;

d =the excess or deficiency of length of the rods as compared with the distance l between the centers of the axles (d=L—l);

α =the angle described by the crank of the coupled axle on the side which we will call the "left-hand" side, measured in circular measure;

δ =the difference in the angles or the angular advance of the driving crank as compared with the corresponding coupled crank;

*Bulletin of the International Railway Congress.

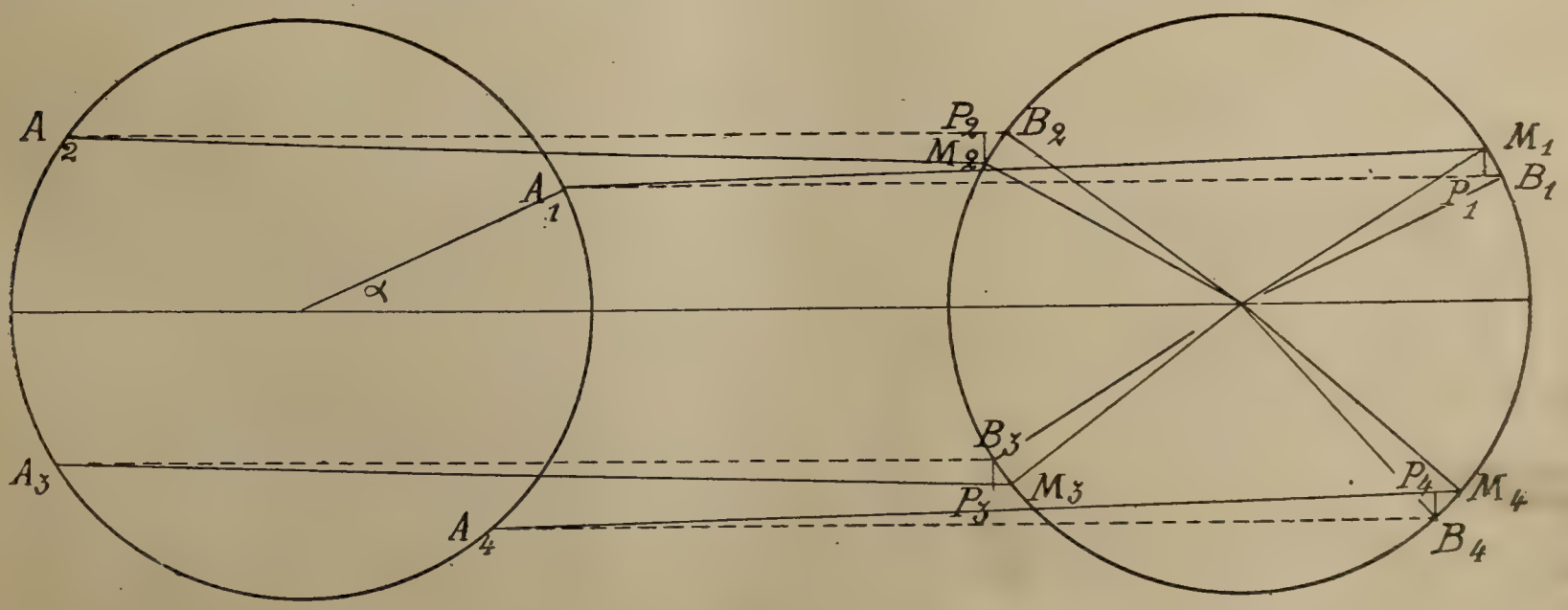


Fig. 1.

f =the longitudinal force with which the crank pin acts on rod;

Es=the product obtained by multiplying the modulus of elasticity by the cross-section of the rod.

Now let us consider the movement, in the first quadrant, of the left-hand rod. We evidently have

$$L-\lambda=a+\frac{f_1 L}{Es} \quad (1)$$

(1).....

or

$$l-\lambda=a-d+\frac{f_1 L}{Es},$$

as d can be either positive or negative.

On the other hand, we have, very approximately,

$$l-\lambda=P_1B_1=M_1B_1 \cos (M_1B_1P_1)$$
$$=M_1B_1 \sin (P_1M_1B_1)$$

or,

$$P_1M_1B_1=a$$

and having with this perpendicular sides

$$M_1B_1=r\delta.$$

Hence:

$$a-d+\frac{f_1 L}{Es}=r\delta \sin a$$

and

$$f_1=\frac{Es}{L}(r\delta \sin a-a+d).$$

In this equation δ is a variable; the inequalities in the wheels coupled together have, in fact, as result the increase or decrease of the angular lead when a varies, so that

$$d\delta=2\frac{D'-D}{D+D'}da,$$

whence

$$(2).....\delta=ma+\gamma,$$

placing

$$m=2\frac{D'-D}{D+D'}$$

and putting γ for the value of δ corresponding to $a=o$.

Consequently:

$$(3).....f_1=\frac{Es}{L}[r(ma+\gamma) \sin a-a+d].$$

Note I.—f_1 is nil when

$$\sin a=\frac{a-d}{r(ma+\gamma)}$$

In an electric locomotive, d is always very small, smaller than a; hence sin a is always positive.

Note II.—If

$$\sin a<\frac{a-d}{r(ma+\gamma)}$$

the expression for f_1 becomes negative.

This does not correspond with what really happens. If in coming backwards, from the position where f_1 is nil, a is progressively reduced, the play a in the equation is no longer a constant. The rod gradually takes up the play of the articulations, without any force acting on it, unless the whole play is absorbed by the backward movement. As the latter case does not turn up in practice, we will not consider it.

We only note that the force f_1 is nil from $a=o$ until

$$a=\text{arc sin}\frac{a-d}{r(ma+\gamma)}$$

The couple transmitted by the coupling gear is expressed by

$$C_1=f_1 r \sin a=$$

$$(4).....\begin{cases}\frac{Es}{L}[r^2\sin^2 a(ma+\gamma)-(a-d)\sin a].\end{cases}$$

Like f_1, it becomes nil when

$$\sin a=\frac{a-d}{r(ma+\gamma)}$$

(and also when $a=o$).

Taking the movement of the rod in the second quadrant, we note that

$$l-\lambda=P_2B_2=M_2B_2\cos P_2B_2M_2=M_2B_2 \sin P_2M_2B_2=r\delta \sin a.$$

What we have said about the first quadrant is hence also strictly true in the case of the second, so that we can put:

$$(5).....C_2=\frac{Es}{L}[r^2\sin^2 a(ma+\gamma)-(a-d)\sin a].$$

C_2 will be nil for the values of a included between

$$a=\text{arc sin}\frac{a-d}{r(ma+\gamma)}$$

and

$$a=\pi.$$

The case of the third quadrant is somewhat different. We have, in fact:

$$-(l-\lambda)=P_3M_3=M_3B_3 \cos B_3M_3P_3$$
$$=M_3B_3 \sin P_3B_3M_3=-r\delta \sin a$$

and

$$-(l-\lambda)=a+d+\frac{f_5 L}{Es}$$

Whence

$$f_3=\frac{Es}{L}[-r\delta \sin a-(a+d)]$$

and as

$$C_3=f_3\times r(-\sin a),$$

we have

$$(6).....C_5=\frac{Es}{L}[r^2\delta \sin {}^2a+(a+d) \sin a]$$

Note.—Sin a being negative in the third quadrant, the term

$$(a+d) \sin a$$

has to be subtracted in a numerical calculation.

The expression for C_4 is identical with that for C_3, as can be shown by considerations similar to the preceding ones:

$$(7).....C_4=\frac{Es}{L}[r^2\delta \sin {}^2a+(a+d) \sin a].$$

Passing to the case of the right-hand rod, we will first of all remark that the movements there are displaced, forward by $\frac{\pi}{2}$.

For these movements we will take the same origin for the angle a as for the left-hand side (1), and we will use the suffix 1 for the magnitudes which we will consider in the second quadrant, because they will combine themselves subsequently with those of the first quadrant of the left-hand side, for which we have used the suffix 1. Similarly, we will use the suffixes 2, 3 and 4 for the magnitudes on the right-hand side, in quadrants 3, 4 and 1 respectively.

We first of all have:

$$f'_1=\frac{Es}{L}r(ma+\gamma) \sin (a+\frac{2}{\pi})-a+d$$

$$f'_1=\frac{Es}{L}r(ma+\gamma) \cos a-a+d$$

and

$$(8).....C'_1=\frac{Es}{L}[r^2(ma+\gamma)\cos {}^2a-r\frac{\pi}{(a-d)}\cos a]$$

$$(9)\ldots\ldots C'_2 = \frac{Es}{L}\left[r^2\,(m\alpha+\gamma)\cos^2\alpha + r\,(a+d)\cos\alpha\right]$$

C'_3 will be expressed by the same formula as C'_2 and C'_4 as C'_1.

In order to obtain a formula for the total couple, all that is necessary is to add together the values of the component couples in pairs, that is to say, C_1 and C'_1, C_2 and C'_2, etc., leaving however out of consideration in this addition the values of the couples when they are nil.

The successive values of α for which one or the other of these couples becomes nil are shown in Figure 2; the couples C_1 and C_4 are thus equal to zero between α_4 and α_1; similarly C'_1 and C'_2 between α'_1 and α'_2; and so on.

where only one of these causes has a definite action, the others being supposed to be nil.

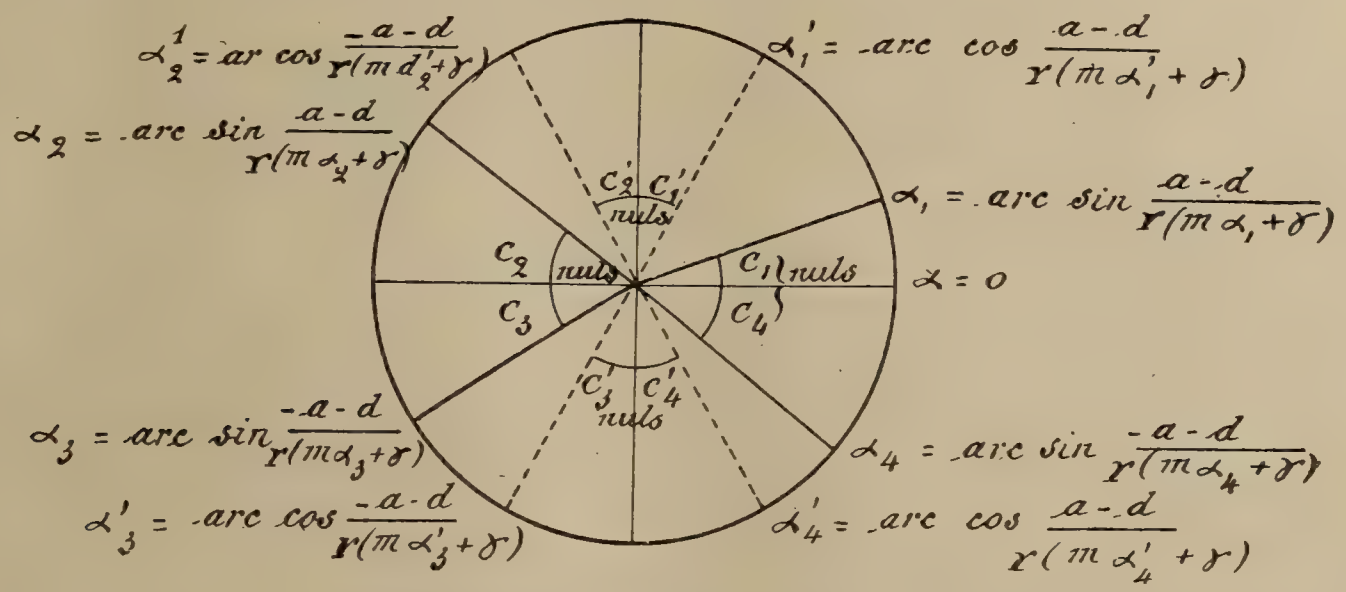
First case.—Let us first of all consider the theoretical case, where

$$m = o, \quad a = o, \quad d = o.$$

It follows from the equations that $C+C'$ is constant at every moment of the movement and equal to

$$\frac{Es}{L} r^2\gamma.$$

If γ is such that



Explanation of the French term : Nuls = Nil.

Starting from $\alpha = o$, we accordingly have as resulting couple :

$$(10)\ldots\begin{cases}
\alpha = o \text{ to } \alpha_1 & C'_1 = \dfrac{Es}{L}\left[r^2\,(m\alpha+\gamma)\cos^2\alpha - r\,(a-d)\cos\alpha\right] \\
\alpha_1 \text{ to } \alpha'_1 & C_1 + C'_1 = \dfrac{Es}{L}\left[r^2\,(m\alpha+\gamma) - r\,(a-d)(\sin\alpha+\cos\alpha)\right] \\
\alpha'_1 \text{ to } \alpha'_2 & C_1 \text{ or } C_2 = \dfrac{Es}{L}\left[r^2\,(m\alpha+\gamma)\sin^2\alpha - r\,(a-d)\sin\alpha\right] \\
\alpha'_2 \text{ to } \alpha_2 & C_2 + C'_2 = \dfrac{Es}{L}\left[r^2\,(m\alpha+\gamma) + r\,(a+d)\cos\alpha - r\,(a-d)\sin\alpha\right] \\
\alpha_2 \text{ to } \alpha_3 & C'_2 \text{ or } C'_3 = \dfrac{Es}{L}\left[r^2\,(m\alpha+\gamma)\cos^2\alpha + r\,(a+d)\cos\alpha\right] \\
\alpha_3 \text{ to } \alpha'_3 & C_3 + C'_3 = \dfrac{Es}{L}\left[r^2\,(m\alpha+\gamma) + r\,(a+d)(\sin\alpha+\cos\alpha)\right] \\
\alpha'_3 \text{ to } \alpha'_4 & C_3 \text{ or } C_4 = \dfrac{Es}{L}\left[r^2\,(m\alpha+\gamma)\sin^2\alpha + r\,(a+d)\sin\alpha\right] \\
\alpha'_4 \text{ to } \alpha_4 & C_4 + C'_4 = \dfrac{Es}{L}\left[r^2\,(m\alpha+\gamma) + r\,(a+d)\sin\alpha - r\,(a-d)\cos\alpha\right] \\
\alpha_4 \text{ to } 2\pi & C'_4 \text{ or } C'_1 = \text{as above.}
\end{cases}$$

Fig. 2.

In drawing figure 2, we have assumed that $\alpha_1 < \alpha'_1$; $\alpha'_2 < \alpha_2$; $\alpha_3 < \alpha'_3$; $\alpha'_4 < \alpha_4$.

But matters may be different. If, for instance, $\alpha_1 > \alpha'_1$, the angular space $\alpha'_1\alpha_1$ may be without couple. If $\alpha_2 < \alpha'_2$ there will also be no couple in the corresponding sector, and so on.

The equations which we have just given are general. In order to analyse the influence of disturbing causes which may come into play, it is convenient to examine the cases where only one of these causes has a definite action, the others being supposed to be nil.

First case.—Let us first of all consider the theoretical case, where

$$m = o, \quad a = o, \quad d = o.$$

It follows from the equations that $C+C'$ is constant at every moment of the movement and equal to

$$\frac{Es}{L} r^2\gamma.$$

If γ is such that

$$\frac{Es}{L} r^2\gamma$$

does not exceed the couple at which adhesion ceases, there accordingly will never be any slipping.

These are the ideal conditions which it is usual tacitly to assume as applying to the systems of coupling rods, conditions which ensure the constancy of the couple transmitted,

not only at the same moments of the successive revolutions, but also at the moments of the same revolution. We shall see, however, how different the conditions are in practice.

Second case.—In this case

$$m <> o;\ a = o;\ d = o.$$

In all the positions of the cranks, the resulting couple will be expressed by

$$C = -\frac{Es}{L} r^2 m\alpha + \gamma).$$

This is the equation to the spiral of Archimedes, the pole of which is defined by

$$\alpha = -\frac{\gamma}{m}.$$

If $m > o$, the couple increases with α and will at a given moment exceed the limit of adhesion. At that moment, there will be slight slipping and the value of γ will fall. But if the rotation continues, slipping will again occur. When $m > o$, the diameter of the coupled wheel being greater, the couple due to the coupling more or less counterbalancing the couple transmitted by the pistons to the driving axle, it will not be that axle which will slip, but the coupled axle.

When $m < o$, in other words, when the diameter of the driving wheel is greater, the couple decreases when α increases; it will reach zero and then become negative. The couple will act on the driving axle in accordance with the couple caused by the driving mechanism, and the driving axle will slip.

Hence the wear caused by the slipping will always affect the wheels whose diameter is greater and will hence tend to reduce this defect.

Third case.—In this case

$$m = o;\ d = o;\ a > o.$$

The diagram, figure 2, becomes symmetrical; in other words,

$$\sin \alpha_1 = \sin \alpha_2 = -\sin \alpha_3 = -\sin \alpha_4,$$
$$\cos \alpha'_1 = -\cos \alpha'_2 = -\cos \alpha'_3 = \cos \alpha'_4.$$

The forces

$$f_1 = f_2 = \frac{Es}{L}(r\gamma \sin \alpha - a),$$
$$f_3 = f_4 = \frac{Es}{L}(r\gamma \sin \alpha + a)$$

can be represented graphically (Fig. 3) by the lengths AA′ intercepted on the vectors by one or the other of the two circle circumferences of radius

$$\frac{Es}{2L} r\gamma,$$

passing through the pole and whose centre O_1 or O_3 is on an axis perpendicular to the polar side, and one circle circumference, described with the pole as centre, and having a radius OR equal to

$$\frac{Es}{L} a.$$

The projection, of the perpendicular to the polar axis, of the intercepted part of the vector will be proportional to

$$C = fr \sin \alpha.$$

On the same diagram we will represent the couples C′, by placing on the polar axis the centres O_2O_4 of the two circles of radius.

$$\frac{Es}{2L} r\gamma.$$

The projection EE′ on the polar axis of the length DD′ intercepted on the vector by the circles OR and O_2 will be proportional to C′.

We can represent the lengths BB_2 and EE′ by ordinates on a Cartesian diagram (Fig. 4), where the abscissæ are proportional to α.

According as the circumference of the circle having O as centre (Fig. 3) cuts the circumferences O_1, O_2, O_3, O_4 within, on or beyond the intersections of these circumferences with each other, we obtain the curves I, II or III.

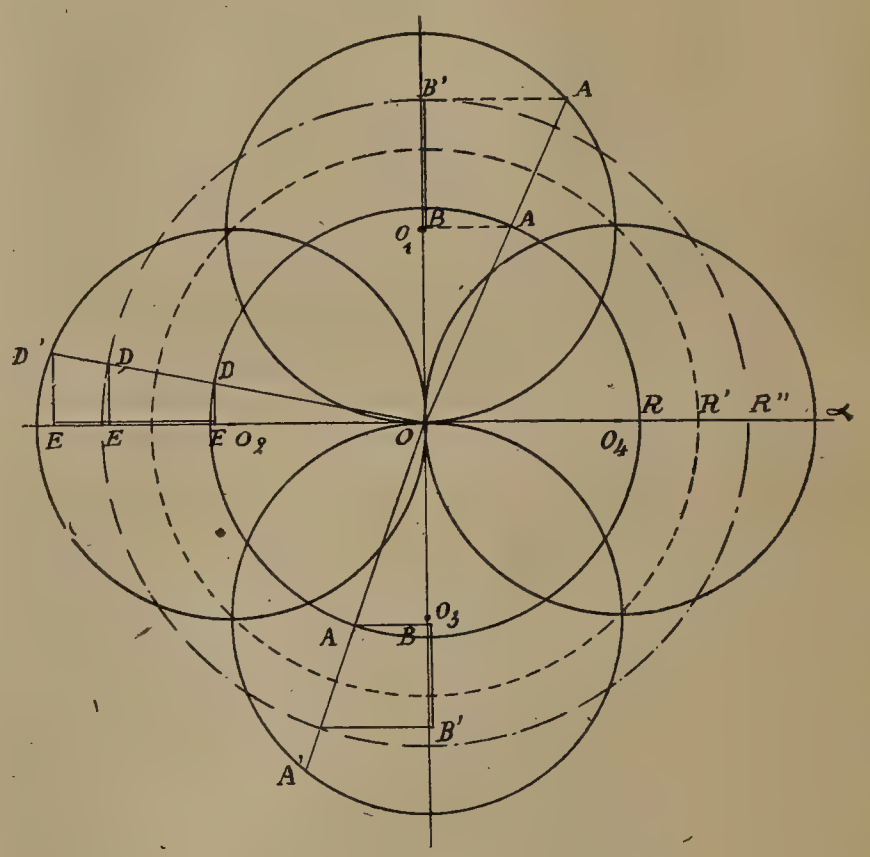


Fig. 3.

In curve I, there is always a couple transmitted in all the positions of the rods, but the value of this couple varies, according to the value of α. At the right angles, only one component couple is acting; the other couple only adds its action to the first near the middle of the intervals. The resulting couple decreases when the play increases and becomes nil (curve II) when (see formula 10 where $m = o$, $d = o$)

$$\sin \alpha = \text{Cos } \alpha = \frac{a}{r\gamma}$$

where

$$\sin \frac{\pi}{4} = \frac{a}{r\gamma}$$

and, finally,

(11). . . . . $a = \frac{r\gamma}{\sqrt{2}}$.

If a has a greater value, the resulting couple is not only variable, but also discontinuous.

Now that is the most usual case in practice, for under normal conditions $r\delta$ can only have a value of some tenths of a millimetre, and one often finds cases where a is greater than one millimetre.

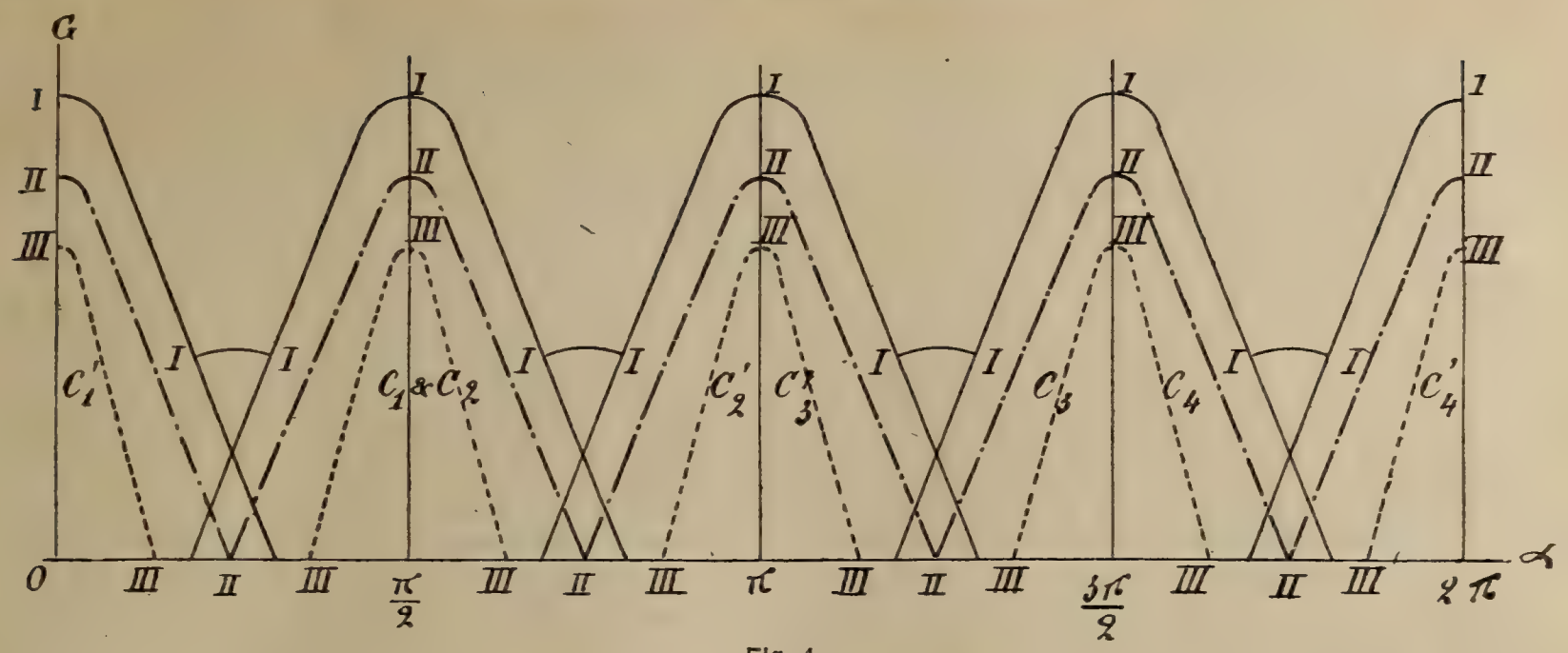


Fig. 4.

The discontinuity of the resulting couple is hence the general rule.

Fourth case.—In this case

$$m = o;\ a = o;\ d <> o.$$

Equations 10 gives, for all positions:

$$(12) \ldots\ldots C + C' = \frac{Esr}{L}[r\gamma + d\ (\sin\alpha + \cos\alpha)];$$

but it must be noted that the signs of sin α and of cos α change according to quadrant.

The polar diagram is easily constructed,

$$\rho = \frac{Esr}{L} r\gamma$$

being a circumference of a circle.

Hence it is only necessary to add to ρ the algebraic sum

$$\frac{Esr}{L} d\ (\sin\alpha + \cos\alpha)$$

or

$$\frac{Esr}{2L} d\ \sin 2\alpha,$$

in order to obtain the points of the curve.

The curve will resemble a flattened circle (I, Fig. 5) if

$$\frac{r\gamma}{d}$$

is always greater than

$$\frac{\sin 2\alpha}{2}.$$

If not, the resulting couple will become nil (II) or even of opposite sign.

The latter case is not to be expected with electric locomotives, as the adjustment of the length of the rods can be effected in practice with great accuracy. It could only arise in consequence of negligence, while in use, in the adjustment of the bearings.

As regards steam locomotives, it must be noted that the rods and the frame plates have different temperatures, and that it is impossible to compensate for these exactly, as they vary.

As our investigation only considers the case of electric locomotives, we will hence only consider the influence of the play and that of the inequality of the diameters of the wheels which are coupled together, conjointly, in a fifth case which we will consider as general.

Fifth case.—In this case

$$m <> o;\ a <> o;\ d = o.$$

General equations 10 become:

$$C = \frac{Es}{L} r\ \sin\alpha\ [r(m\alpha + \gamma)\ \sin\alpha - a],$$

$$C' = \frac{Es}{L} r\ \cos\alpha\ [r(m\alpha + \gamma)\ \cos\alpha - a].$$

Polar diagram.—With the pole O as center (Fig. 6) describe a circumference having as radius

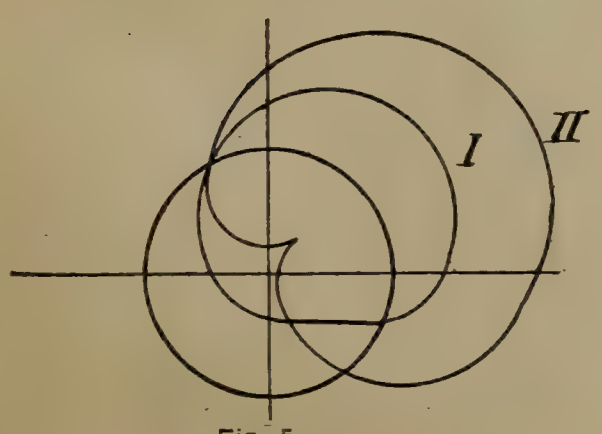


Fig. 5.

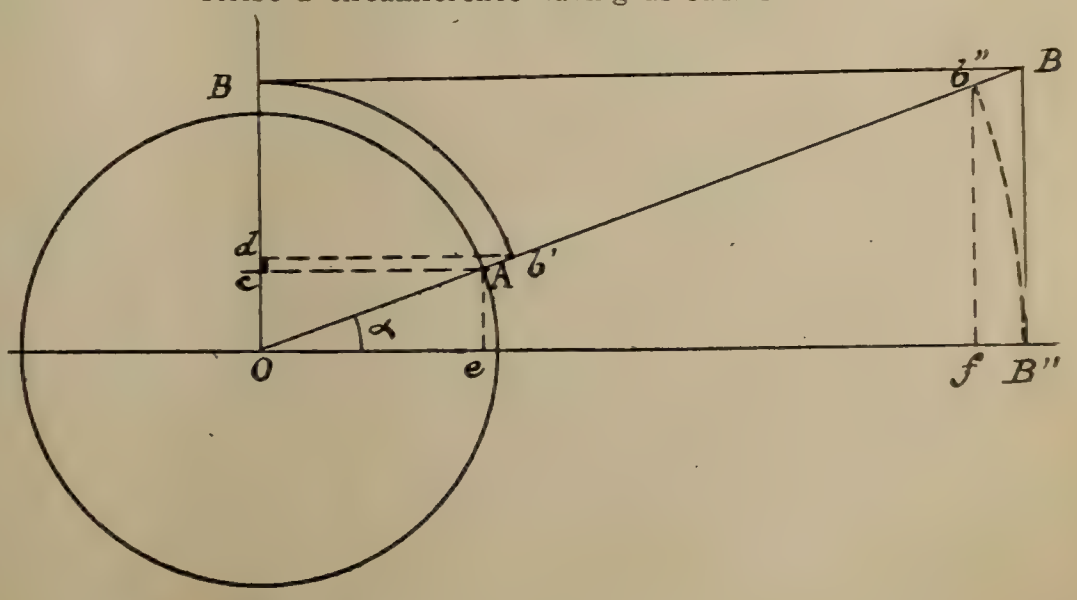


Fig. 6.

$$\frac{Es}{L} ra$$

and draw a vector OB at an angle a to the polar axis. On this vector take from O a length OB' of relative value

$$\frac{Es}{L} r[r\,(ma+\gamma)];$$

$$OB' = Ob' = \frac{Es}{L} r\,[r(ma+\gamma)]\,\sin a;$$

$$OB'' = Ob'' = \frac{Es}{L} r\,[r(ma+\gamma)]\,\cos a,$$

and

$$Od = \frac{Es}{L} r\,\sin a\,[r(ma+\gamma)]\,\sin a;$$

$$Of = \frac{Es}{L} r\,\cos a\,[r(ma+\gamma)]\,\cos a.$$

On the other hand,

$$Oc = \frac{Es}{L} ra\,\sin a$$

and

$$Of = \frac{Es}{L} ra\,\cos a.$$

Consequently:

$$cd = \frac{Es}{L} r\,\sin a\,[r\,(ma+\gamma)\,\sin a - a] = C;$$

$$ef = \frac{Es}{L} r\,\cos a\,[r\,(ma+\gamma)\,\cos a - a] = -C'.$$

These lengths transferred to a Cartesian diagram will give us as ordinates the values of the component couples, the abscissæ being proportional to a.

Note.—The locus of points b' is a curve which resembles the circumference of a circle passing through O and whose pseudo-center is a point near the line OB'.

Similarly the locus of points b'' is a similar curve, passing through the pole and whose center is a point near OB''.

Application of the Graphic Method.

(Figs. 7 and 8.)

We will take, as representing conditions in practice:

$D = 2{,}000$ millimetres;

$D' - D = 0.6$ millimetre;

whence

$m = 0.0003$;

$r = 300$ millimetres;

$a = 0.5$ millimetre;

$l = 2{,}400$ millimetres;

$s = 3{,}000$ square millimetres.

We will also assume, in order to simplify matters, that $\gamma = o$; that is to say that at the beginning of the rotation the cranks are accurately parallel. Finally, we will assume the length of the rods to be true, in other words, $d = o$.

On the polar diagram, using an arbitrary scale which will be retained for the other magnitudes, we draw a circle having its center at the pole, with a radius proportional to

$$\frac{Es}{l} ra.$$

Then, by the method described, we determine the curves whose vectors projected respectively on the vertical axis and on the horizontal axis are proportional to

$$\frac{Es}{L} r^2 ma\,\sin {}^2a$$

and

$$\frac{Es}{L} r^2 ma\,\cos {}^2a.$$

These projections, diminished by the projection of the corresponding vector of the circle,

$$R = \frac{Es}{l} ra$$

represent the value of the couple C or of the couple C'.

Let us apply the magnitudes so projected, to a Cartesian diagram, in which the abscissæ represent the angles of rotation, and the ordinates the values of the couples.

We note that at the beginning of the movement and until a attains a value of about 335°, no couple appears, the play a sufficing to absorb the angular lead due to the factor ma. Starting from 335°, a couple appears, on the right-hand side, as the polar diagram shows. It increases and attains its maximum a little beyond $a = 360°$; then it diminishes and vanishes.

From about $a = 400°$ to $a = 410°$, no couple is transmitted to the coupled axle.

From $a = 410°$, the left-hand rod begins to make its action felt and a stronger couple than the first is transmitted. Its maximum is attained a little beyond the right angle ($a = 450°$). It then diminishes, but near $a = 490°$, the couple on the right-hand side appears and adds its increasing value to the decreasing value of the left-hand couple. From this point onwards, the total couple always retains a definition value, but the magnitudes increase and at a given amount exceeds the limit of adhesion.

If we fix this limit at 3,000 kilograms for the coupled axle, drawing a horizontal line to the ordinate for 3,000 kilograms at 1 metre (wheels having a radius of 1 metre), we see that slipping is unavoidable at the point at which $a = 530°$ approximately.

This slipping will change the angular lead; it may reduce it, or make it nil, or even make it of opposite sign. The transmitted couple will hence be reduced or made equal to zero, but as the rotation continues, its magnitude will gradually increase until the limit of adhesion is reached, and then slipping will again occur, and soon.

Note.—We have assumed that the diameter of the driving wheels was smaller than that of the coupled wheels.

In the opposite case, m would be negative. The couple, which would still equal zero at the start, would quickly

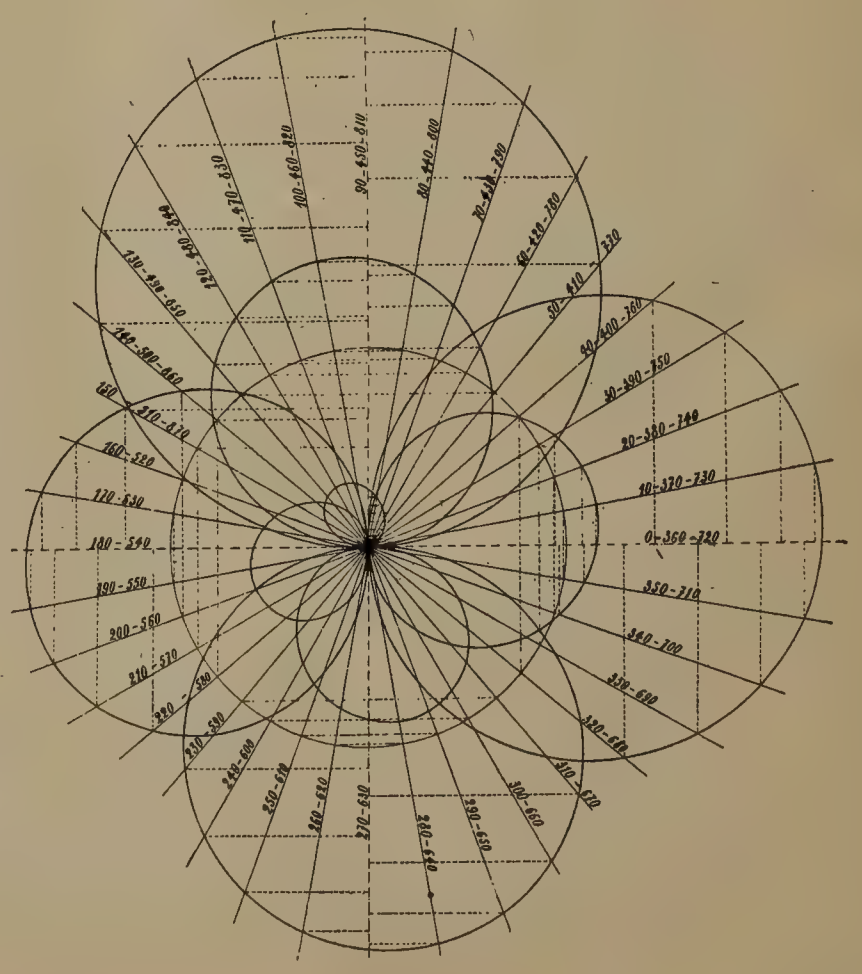


Fig. 7.

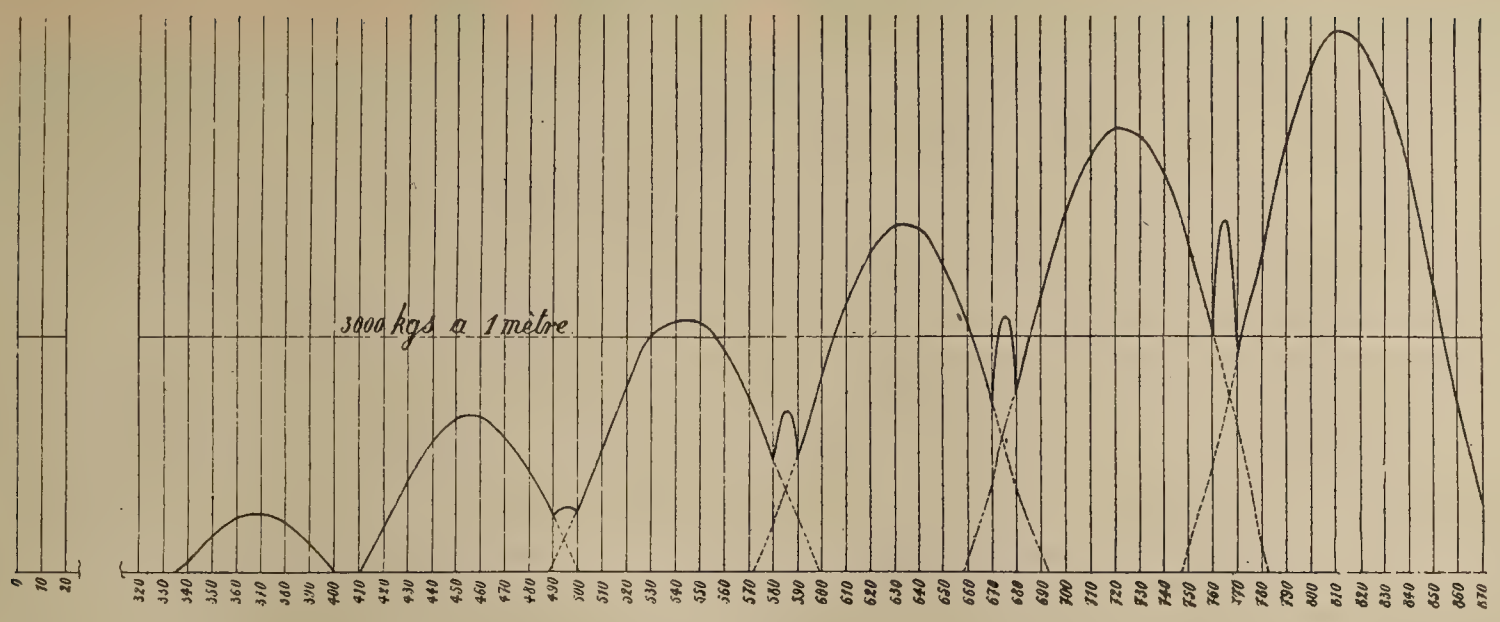


Fig. 8.

take a negative value which would act on the driving axle as if the coupling rods were driving rods; the driving axle would be acted on in the same way by the driving rods and by the coupling rods. The driving wheels would accordingly slip and a new state of affairs would result. In this new state, an angle δ would make the coupling work normally during a few moments; but the new angular advance, equal to $\gamma - m\alpha$ would very soon equal zero and then become of opposite sign. Slipping would ensue and these phenomena would be repeated.

The above considerations led to the following conclusions:

1° The couple transmitted by the coupling rods from constant during a revolution, and also varies from one revolution to another;

2° Very slight slipping, which is however repeated periodically, is produced by the coupling, whether the engine is acting as motor or is running with regulator closed. This peculiarity explains the notable increase in the internal resistances of a locomotive when, with a given weight, the number of its coupled wheels is increased;

3° It is advisable, in order to increase the mean value of the couple transmitted, to reduce to a minimum the play in the articulations of the coupling rods, and to keep it at this minimum during use. The momentary values of the couple will in this way be made more constant, and can consequently have a higher value, without reaching the limit of adhesion. This will improve the coefficient of adhesion of the locomotive taken as a whole;

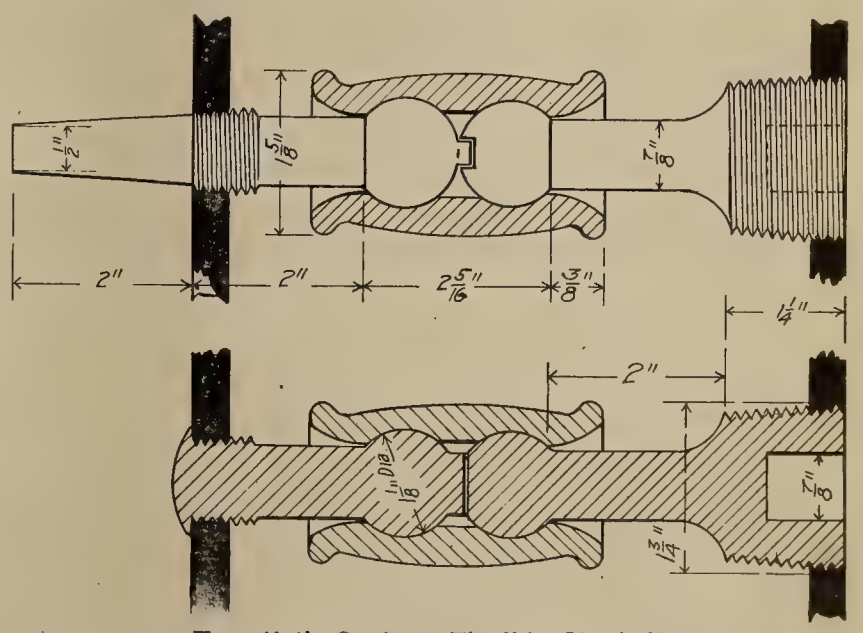
4° In order to maintain this constancy from revolution to revolution, care must be taken to have the diameter of the coupled wheels strictly equal. In this case, the rolling resistance of the engine will be reduced to a minimum. It has vainly been attempted on some railways, to bring about this state of affairs by giving the crank pins excessive play in their bearings;

5° As the force given by the connecting roads of steam locomotives is fairly constant and in all cases always keeps of the same sign, it may be assumed that it counteracts the irregularities of the action of the coupling rods, and only inevitable slipping is left. But if the driving couple has variations during the revolution which change its value from positive to negative (locomotive using single-phase current), resonance effects can be produced which may subject different parts of the mechanism to unexpected stresses; and this may explain the bad results which have been obtained with rod transmission in the case of some single-phase electric locomotives.

This modest investigation has evidently no pretension of elucidating all the questions in connection with the use of coupling rods. Our only object is to draw the attention of designers to these questions and to ask for the help of their observations and, above all, for the results of actual experience which alone can act as true touchstone to confirm the conclusions of this necessarily incomplete analysis.

FLEXIBLE STAYBOLT.

The Twentieth Century Flexible Staybolt is the name of a new flexible staybolt recently patented by H. A. Lacerda, boiler inspector of the New York Central at the West Albany, N. Y., shops. As may be seen in the illustration, the bolt consists of three parts, the staybolt proper being in two sections, the ends being formed in a ball shape and joined together by a sleeve. One of these ball-shaped ends has a key which fits into a recess in the other ball, thus forming with the sleeve a continuous bolt. This enables it to be inserted in the manner of the ordinary staybolt and



Twentieth Century Flexible Staybolt.

at the same time the inventor claims it permits equal flexibility in either the inner or outer sheet. As will be noted, the outer end of the bolt is enlarged and of such diameter as to allow the sleeve to pass through it.

Under test the bolt failed in the solid part under a stress of 48,000 pounds per square inch. The cost of construction is low, as by the use of suitable dies the balls and sleeve can be formed in simple operations. It is stated that it can be tested with safety by the hammer test and that it meets the requirements of the public service commission. The cost of manufacture is said to be low and the inventor is desirous of giving the railways an opportunity to manufacture it, as it can be made in the ordinary railway shop. The sleeve has been improved on and can be manufactured much smaller than shown in the illustration.

MALLET COMPOUND LOCOMOTIVES, MISSOURI, OKLAHOMA & GULF RY.

The Baldwin Locomotive Works has recently completed five Mallet articulated locomotives of the 2-6-6-2 type for the Missouri, Oklahoma & Gulf Ry. These engines are intended for road service and can be operated on 70-pound rails. They develop a tractive force of 61,000 pounds working compound, or about 13 pounds per square foot of total equivalent heating surface. The driving wheels carry 88 per cent of the total weight of the locomotive. These ratios are similar to those usually found in locomotives of the consoldiation type, and they indicate a design which is suitable for heavy, slow-speed service. The locomotives will operate over grades of 0.6 per cent, and they have a hauling capacity of 3,000 tons on such grades.

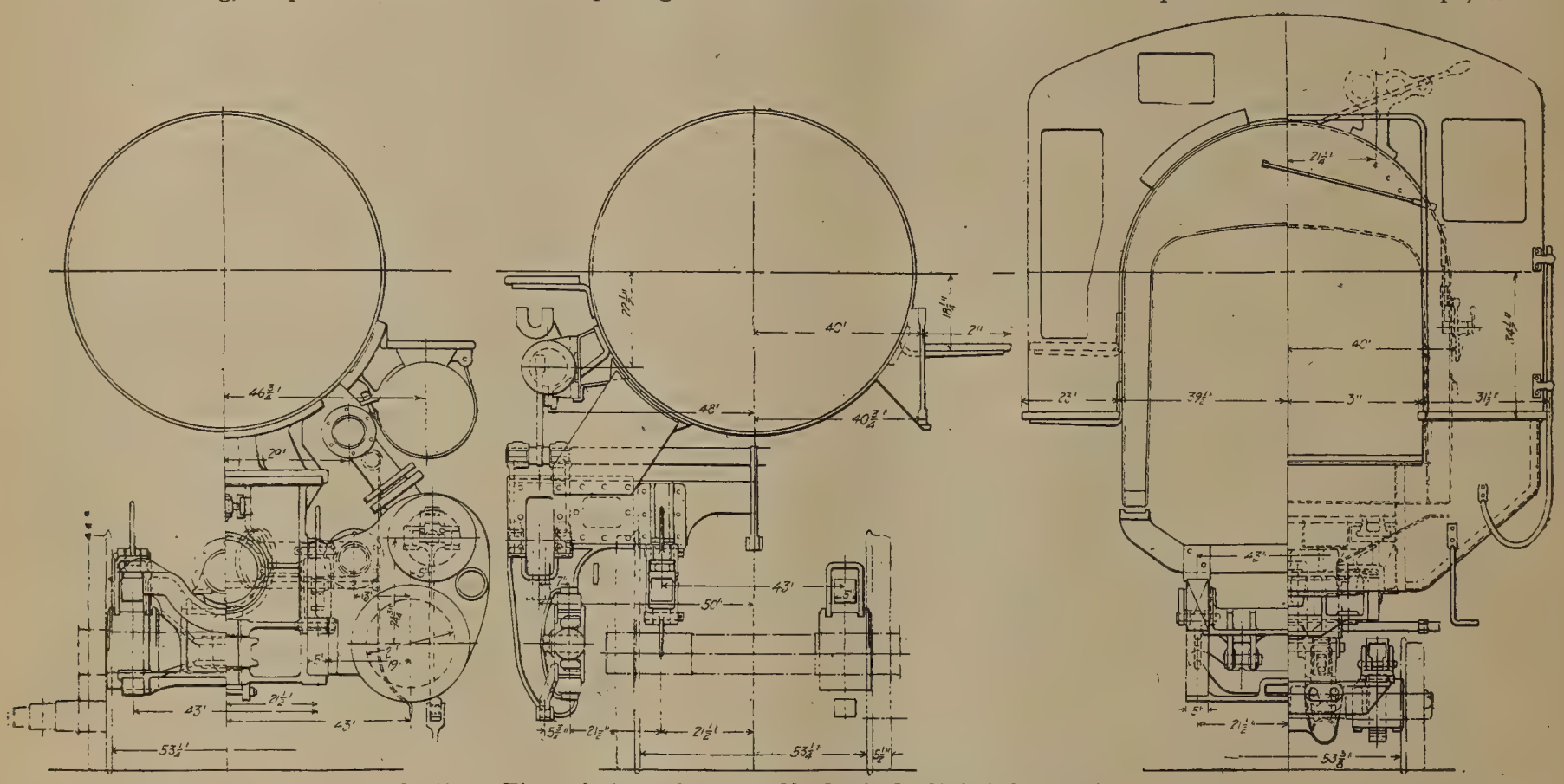
The boiler used in this design is of the straight-top type, with Schmidt super-heater. The latter is composed of 26 elements. The main dome is centrally located on the second boiler ring; it is of pressed steel in one piece, and is 33 inches in diameter by 24 inches high. The auxiliary dome, on the third ring, is placed over a 16-inch opening in the shell, so that the boiler can be entered for inspection purposes without dismantling the fittings in the main dome. This boiler is built with diamond longitudinal seams on the top center line. The seam on the first ring is welded for 12 inches at each end, while the seams on the two dome rings are welded throughout their entire lengths.

The steam piping is arranged in accordance with the usual practice for Mallet locomotives, having super-heaters. The pipes conveying steam from the super-heater to the high-pressure cylinders are fitted with expansion joints. A similar joint is placed in the front end of the receiver pipe. This pipe is so arranged that the center line of the ball-joint coincides with that of the articulated frame connection. The steam distribution to all the cylinders is controlled by 13-inch piston valves. The high-pressure valves are arranged for inside admission and the low pressure for the outside admission. All the cylinders are fitted with by-pass valves of the Sheedy type. Each high-pressure cylinder and steam chest has a separate oil-feed, while the low-pressure cylinders are oiled from a feed which is tapped into the receiver pipe.

The frames are five inches wide, and are each cast in one piece. The front sections of the rear frames are in the form of single rails, which extend forward between the cylinder castings and central saddle. Each cylinder casting is held in place by 25 horizontal bolts. Of these 11 are 1½ inches in diameter and the remainder are 1¼ inches in diameter. The 1½-inch bolts pass through the frame. In this way the bolts are largely relieved of shearing strains, and the various parts are fitted with large bearing areas so that there is but little tendency for them to work loose. Furthermore, with separate castings, it is an easier matter to remove the cylinders, than when a divided saddle is used.

The low-pressure cylinders are supported directly by a central casting, which is secured to the front frames with slab fits, and bolted and keyed in accordance with the usual practice of the builders. This construction was adopted in 1909 and has been used since with most satisfactory results.

The weight of the boiler is transferred to the front frames through a single bearer, which is placed between the second and third pairs of driving wheels. The front bearer is placed under the smoke-box and normally carries no load. This bearer is fitted with a pair of cast-steel clamps, which



Sections Through Rear Frames, M. O. & G. Mallet Locomotives.

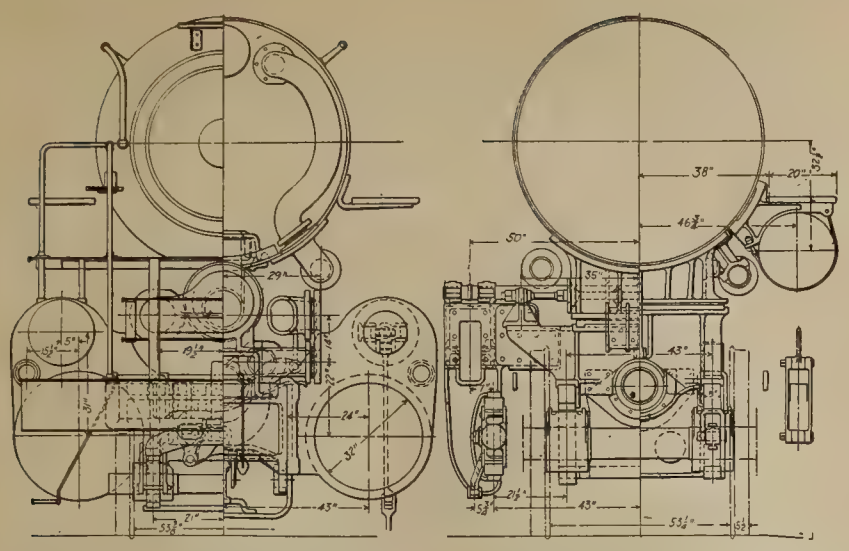
are strongly ribbed and prevent the frames from falling away when the boiler is lifted.

The equalization is continuous in each group of wheels. The front truck is center bearing and is equalized with the driving wheels as in a locomotive of the mogul or consolidation type; while the rear truck is side bearing, and is also equalized with the drivers by a beam on each side. The firebox is placed over the rear pair of driving wheels, and there is practically no overhang at the back end.

The tender is of a long, low design, with capacity for 8,000 gallons of water and 13 tons of coal. The frame is composed of 12-inch channels, and the trucks are of the arch-bar type with "Standard" rolled steel wheels.

A table of dimensions and weights is given below:

Type	2-6-6-2
Service	Freight
Cylinders	21 and 32 by 30 ins.
Valves	Balanced piston
Tractive power	6,100 lbs.
Boiler, type	Straight
Min. diameter	74 ins.
Working pressure	210 lbs.
Firebox, size	66 by 116 ins.

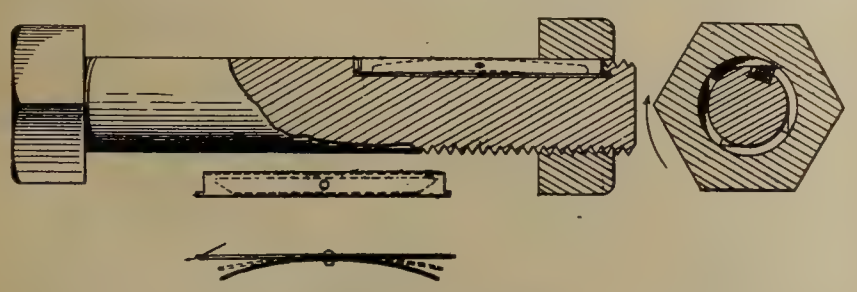


Sections Through Front Frames, M. O. & G. Mallet Locomotives.

Grate area	53.4 sq. ft.
Kind of fuel	Soft coal
Tubes, number	26 and 191
Diameter	5½ and 2¼ ins.
Length	21 ft. 0 ins.
Heating surface, firebox	198 sq. ft.
Tubes	3,209 sq. ft.
Total	3,407 sq. ft.
Super-heating surface	685 sq. ft.
Driving wheels, diameter	55 ins.
Journals	9½ by 12 ins.
Truck wheels, front, diameter	31 ins.
Journals	6 by 12 ins.
Back, diameter	31 ins.
Journals	6 by 12 ins.
Weight, on driving wheels	277,100 lbs.
Total, engine	315,800 lbs.
Total, engine and tender	470,000 lbs.
Wheel base, driving	28 ft. 11 ins.
Total, engine	43 ft. 9 ins.
Total, engine and tender	72 ft. 8½ ins.
Tender, wheels, diameter	33 ins,
Journals	5½ by 10 ins.
Capacity, water	8,000 gallons
Capacity, coal	13 tons

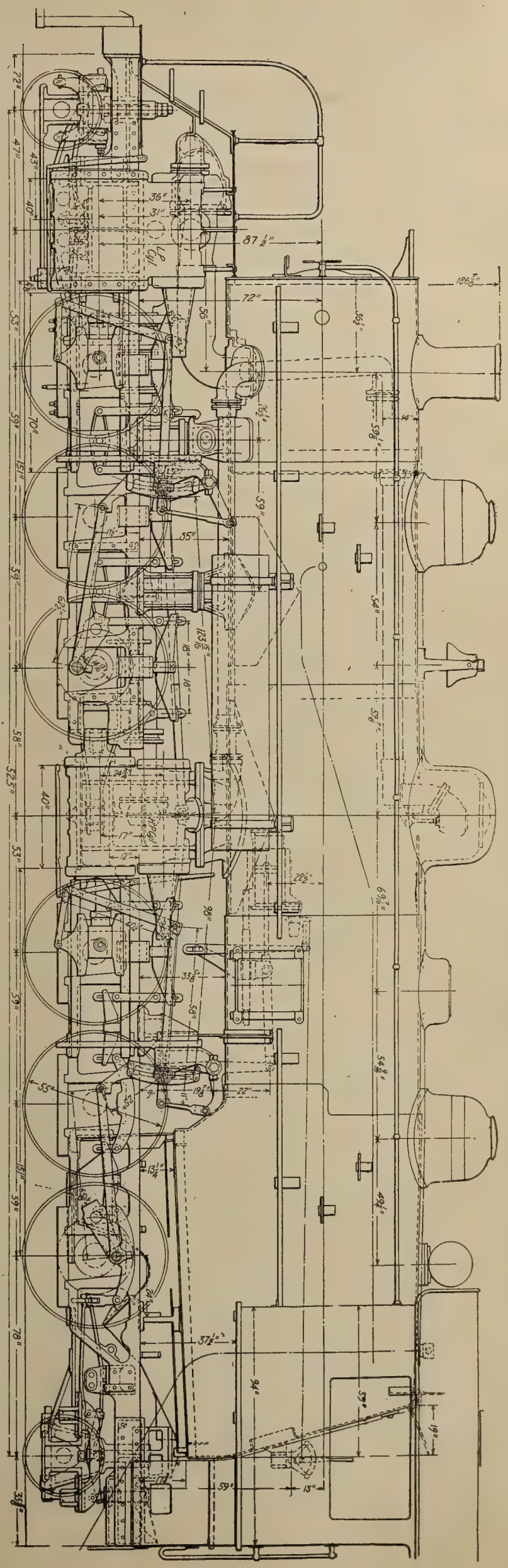
NUT LOCK.

The nut lock shown in the illustration was patented in 1909 by P. P. Jargick and is now owned by F. C. Schultz, chief interchange inspector at Chicago. It is essentially a ratchet device, and its construction may be readily understood from the sketch. There is a channel in the bolt extending longitudinally across the threads and containing a rectangular locking member. This member is free to rock and has a small spring underneath, which causes the locking member to engage in ratchet grooves in the nut. It is a positive lock and, of course, is adapted especially for use in places where such a lock is absolutely necessary. It is claimed that it can be manufactured at a very low figure.



Ratchet Nut Lock.

The Lake Shore & Michigan Southern, it is said, is considering the purchase of additional motive power equipment.



Elevation drawing, Mallet Compound Locomotives, M. O. & G. Ry.

RAILWAY NOTES.

The Burlington Belt Line has been organized by residents of Burlington, Iowa, to build about 65 miles of line from Burlington southeast to Beardstown, Ill.

The Carolina R. R. has been incorporated with a capital of $175,000 and headquarters at Kinston, N. C., to build from Kinston north to Snowhill, about 20 miles. The incorporators are I. C. Millard, M. S. Hawkins and H. Hanley, of Norfolk, Va., and W. H. Hayes, Kinston, N. C.

The Dominion Northwestern has applied for incorporation to construct a line from Regina, Sask., west to Tuxford on the Canadian Pacific and thence to Red Deer, Alta., with a branch through Battleford, Sask., to Fort McKay.

It is said that the Great Northern contemplates the operation of its new line, the Montana & Eastern, by electricity. A portion of this new road is to be constructed shortly, the contract having been let to A. Guthrie & Co., St. Paul, Minn.

The Illinois Central, it is reported, has completed surveys for the construction of a new line from Jackson, Miss., up Pearl river valley.

The Marinette, Tomahawk & Western has been issued a charter in Wisconsin. The company is capitalized for $250,000. R. B. Tweedy, of Tomahawk, is principal owner.

The Minneapolis, St. Paul & Sault Ste. Marie has given a contract to Foley Brothers, Welch & Stewart, St. Paul, Minn., to build an extension from Ambrose, N. D., to a point in Montana 75 miles west of Ambrose.

The Moberly, Huntsville & Randolph Springs has been incorporated in Missouri with a capital of $500,000 to build from Randolph Springs, Mo., east to Moberly in Randolph county, 12 miles. The directors include C. H. Dameron, W. T. Dameron, G. P. Dameron and W. M. Evans, of Huntsville, Mo.

The Port St. Joe Dock & Terminal, Port St. Joe, Fla., has been chartered to construct and operate a railroad along the eastern coast of St. Joseph's Bay.

A plan for the construction of a railroad between Greenfield and Wilmington, Vt., is before the Vermont Legislature. The plans, which are at present under consideration, would give direct connection through Wilmington to Manchester, and afford a connection, through to the Rutland R. R.

The Seaboard Air Line, it is reported, is considering a proposition for building an extension from Wellington, Ala., to Gadsden.

The Southern Pacific is said to have acquired the last right of way for a low grade line over the Tehachapi Mountain between Mojari and Kern City, and that the construction work on the line, which will cost about $10,000,000, will be begun in the near future.

The Carolina & Northwestern nas ordered 4 consolidation locomotives from the Baldwin Locomotive Works.

The Cincinnati, New Orleans & Texas Pacific it is reported, has ordered 10 consolidation locomotives from the Baldwin Locomotive Works.

The Cuba R. R. has ordered 4 ten-wheeled locomotives with 18x24 in. cylinders and 52 inch driving wheels, from the American Locomotive Co.

The Delaware & Hudson has ordered 15 consolidation locomotives from the American Locomotive Co.

The Harriman Lines are closing negotiations for about 200 locomotives with the Baldwin Locomotive Works and the American Locomotive Co.

The Lake Superior Terminal & Transfer Co., it is reported, has ordered an eight-coupled switching locomotive from the Baldwin Locomotive Works.

Lehigh Valley has ordered 10 mikado locomotives from the Baldwin Locomotive Works.

The Pittsburg, Shawmut & Northern has ordered 12 mogul locomotives from the Baldwin Locomotive Works.

The Illinois Central has placed an order for 25 Pacific type locomotives and 30 switch locomotives.

The Arizona Eastern has placed an order for three 69 foot steel combination baggage and mail cars, one 60-foot steel baggage car, six 60-foot steel coaches, one hundred 100,000 pound capacity box cars and 3 steel water cars, for this years delivery.

The Arizona & New Mexico has ordered one observation car from the Barney & Smith Car Co.

The Chicago & North Western is having 34 engines built at the Baldwin Locomotive Works, five of which are for the C., St. P., M. & O. Ry. These engines will be fully equipped with Markel removable driving box brasses, flangeless shoes and wedges, removable lateral motion plates on driving boxes and solid end main rods. This road is also having a number of engines built by the American Locomotive Co. These engines will also be equipped with the Markel devices, which are handled by the Locomotive Improvement Co. of Clinton, Iowa.

New Books

AMERICAN RAILWAY MASTER MECHANICS ASSOCIATION. Proceedings of the forty-fifth annual convention. Cloth, 6½x9 inches, 432 pages, together with insert drawings. Published by the Association under the direction of Jos. W. Taylor, secretary, 390 Old Colony Bldg., Chicago.

The volume contains the proceedings of the sessions held at Atlantic City on June 17, 18 and 19, 1912, embracing the committee reports and discussion of same, drawings of the standards of the Association, copy of constitution and by-laws, list of members and other matters pertinent to the Association. Among the subjects discussed are mechanical stokers, locomotive frames, main and side rods, safety valves, design of boilers, tire contour and tires, flange lubrication, headlights, superheaters and engine-tender wheels. The volume contains a goodly number of illustrations, and the editing and mechanical work is in accordance with high standard of the Association.

* * *

THE "MECHANICAL WORLD" POCKET DIARY AND YEAR BOOK. Cloth, 4x6¼ inches, 400 pages. Published by Emmott & Co., Ltd., 65 King St., London, England. Price, sixpence (twelve and a half cents).

The twenty-sixth issue of a year book by the publishers of the "Mechanical World." It contains tables and much reading matter of value to the mechanical man, treating of the steam engine, boilers, gas engine valves, gears, belting, chain driving and other kindred subjects. The matter on gas engines and producers has been entirely revised in this issue.

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THE "MECHANICAL WORLD" POCKETBOOK. Cloth, 4x6¼ inches, 300 pages. Published by Emmott & Co., Ltd., 65 King St., London, England. Price, six-pence (twelve and a half cents).

A hand book issued yearly and similar to the Mechanical pocketbook in general arrangement. It contains the latest information and data on the subjects of resistances, motors, transformers, boosters, electric lighting, electric welding, measuring instruments, circuit breakers and wiring.

* * *

TRAVELING ENGINEERS' ASSOCIATION. Proceedings of the twentieth annual convention. Leather, 6x9 inches, 450 pages. Published by the Association under the direction of the secretary, W. O. Thompson, East Buffalo, N. Y.

The object of this Association is to improve the locomotive

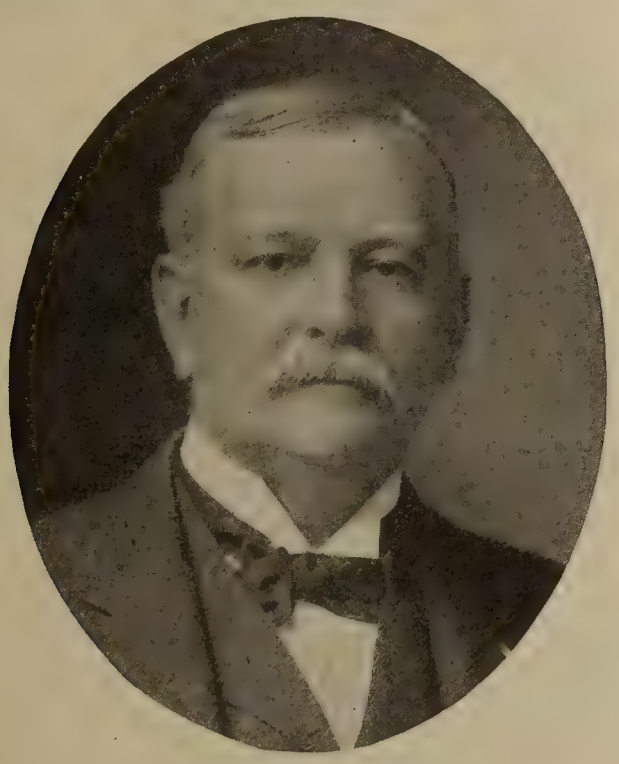
engine service of American railroads, and the contents of this volume, containing the report of the annual convention at Chicago in August, 1912, show that its members are living up to the object of the Association. Among the subjects discussed in this volume are: Instructions on handling superheated locomotives, credit due the operating department in reducing fuel consumption, care of locomotive brake equipment, advantage of the brick arch, eliminating black smoke, and tonnage rating.

OBITUARY.

Roswell Miller.

Roswell Miller, chairman of the board of directors of the Chicago, Milwaukee & St. Paul, died in his home in New York City January 3. He had suffered of apoplexy for several years, and it is thought he had a stroke in the night, dying without being able to call for assistance.

Mr. Miller was born in Harford, Pa., Oct. 28, 1843. He was educated in the public schools and academy of that town, and when he left school he immediately entered the service of the Cairo & Vincennes R. R. His rise was rapid in that service and he soon became secretary. Then he was appointed superintendent and held that position until 1882, when he changed to the Chicago & Western Indiana R. R., becoming second vice president and treasurer. He entered the service of the Chicago, Milwaukee & St. Paul Ry. in 1883, as assistant to the general manager. He was promoted to general manager at the death of S. S. Merrill



Roswell Miller.

in 1885. He was elected president in April, 1888, to fill a vacancy caused by the death of Alexander Mitchell a year previous. He became the first chairman of the board of directors in 1899, which position he has held continuously until his death. From 1888 to 1890 he was doing double service on the Chicago, Milwaukee & St. Paul as president and general manager, but was relieved of duties of chief operating official in 1890. During the years of his presidency the railway made great industrial strides which made possible the Puget Sound extension which Mr. Miller later financially engineered while chairman of the board.

Mr. Miller was a man of sterling integrity, of commanding force, of firm convictions, quick to take the necessary action to meet an ever changing situation, his counsel was of inestimable value to his company during a trying period in its history, and, with his later guidance of its affairs, made secure to him a position of preeminence in his chosen profession.

Personals

Chicago & Alton.

M. McGraw has been appointed master mechanic with office at Bloomington, Ill., succeeding W. E. Ladley, resigned.

Chicago, Millwaukee & St. Paul.

R. W. Anderson has been appointed master mechanic of the Puget Sound Lines with office at Miles City, Mont.

G. E. Cessford, master mechanic, has been transferred from Miles City to Deer Lodge, Mont.

T. J. Hamilton, master mechanic, has been transferred from Deer Lodge, Mont., to Tacoma, Wash.

Chicago, Rock Island & Pacific.

T. Rumney has resigned as assistant second vice-president.

W. J. Tollerton, mechanical superintendent, has been appointed general mechanical superintendent in full charge of the mechanical department.

F. Connolly has been appointed supervisor of locomotive operation of the Kansas City terminal and Kansas division,

W. J. Tollerton.

with headquarters at Herington, Kansas. Mr. Connolly was formerly road foreman of equipment at the same place.

S. T. Patterson has been appointed supervisor of locomotive operation of the Chicago terminal and Illinois division, at Little Rock, Ark. Mr. Patterson was formerly road foreman of equipment at Argenta, Ark.

R. E. Wallace has been appointed supervisor of locomotive operation of the Chicago terminal and Illinois divisions, with headquarters at Chicago. Mr. Wallace was formerly assistant road foreman of equipment at the same place.

C. S. Yeaton has been appointed supervisor of locomotive operation of the Oklahoma division, with headquarters at El Reno, Okla. Mr. Yeaton was formerly road foreman of equipment at the same place.

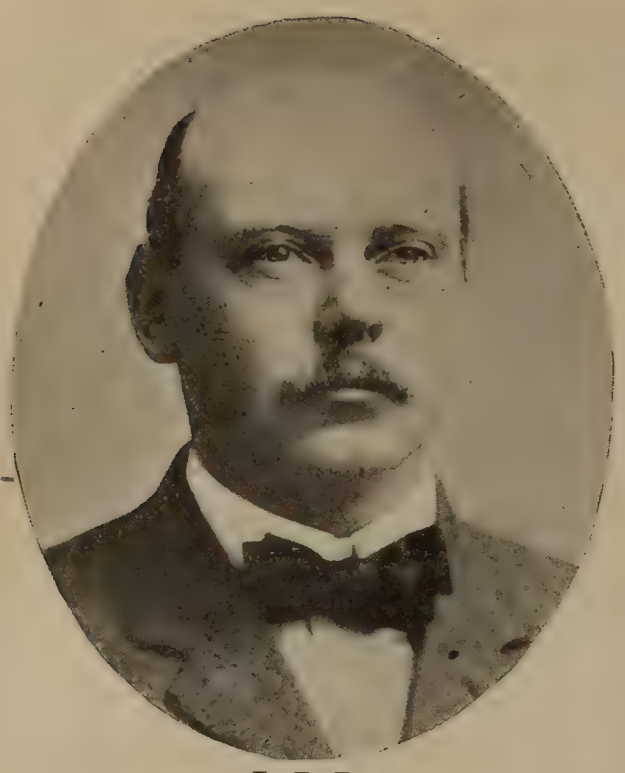
Chicago, St. Paul, Minneapolis & Omaha.

C. Larson succeeds M. J. Keating as traveling engineer with office at Minneapolis, Minn.

F. M. Podruck has been appointed foreman of locomotive repairs with office at Elroy, Wis. He succeeds H. A. Enockson, who has been transferred to Altoona, Wis.

Cincinnati, Hamilton & Dayton.

C. M. Hitch, general foreman car department at Lima, Ohio, has been promoted to the position of general foreman of the locomotive and car department.



E. F. Fay.

Erie.

John McMullen has been appointed mechanical superintendent in charge of the car department, with headquarters at Meadville, Pa. He succeeds E. A. Westcott, assigned to other duties.

William Miller has been appointed shop superintendent, vice Adam Trautman, with office at Kent, O.

Adam Trautman has been appointed shop superintendent, with office at Buffalo, N. Y.

Great Northern.

R. Budd has been appointed assistant to the president, with office at St. Paul, Minn.

G. E. Perry.

F. A. Bushnell has been appointed purchasing agent with office at St. Paul, Minn., succeeding the late S. B. Plechner.

H. Craswell has been appointed locomotive foreman at Sioux City, Ia., succeeding Geo. Nichols, transferred to New Rockford, N. D.

J. Doherty has been appointed car foreman with office at Kelly Lake, Minn. He succeeds F. Karl.

O. A. Hanson has been appointed car foreman at New Rockford, N. D.

John O'Brien has been appointed locomotive foreman with office at Delta, Wash. He succeeds T. J. Precious, transferred to Gold Bar, Wash.

Hocking Valley.

J. R. Mueller succeeds C. B. Duffy as purchasing agent, with office at Columbus, O.

Illinois Central.

E. F. Fay has been appointed assistant master mechanic with office at Waterloo, Ia.

Intercolonial.

H. W. Sharpe has been appointed master mechanic of the Intercolonial Ry. of Canada, succeeding Thos. Ryan. His office is at Riviere du Loup, Que.

Minneapolis, St. Paul & Sault Ste. Marie.

J. W. Hendry has been appointed assistant master mechanic with office at Thief River Falls, Minn. He succeeds E. Foster, transferred to Superior, Wis.

Missouri, Kansas & Texas.

Wm. O'Herin has been appointed assistant to General Manager Webb, with headquarters at Dallas, Texas. Mr. O'Herin was formerly superintendent of motive power.

Missouri, Oklahoma & Gulf.

G. E. Perry has been appointed superintendent of motive power with office at Muskogee, Okla. He was formerly master mechanic at the same place.

New York Central & Hudson River.

E. V. Williams has been appointed general foreman of the locomotive department at West Albany, N. Y. He succeeds T. H. Leonard.

New York, Chicago & St. Louis.

C. L. Cooper has been appointed roundhouse foreman at Ft. Wayne, Ind., vice George James.

Norfolk & Western.

A. C. Needles has been appointed general manager with office at Roanoke, Va. Mr. Needles was formerly general superintendent of the Eastern division.

Norfolk Southern.

J. T. Mallard has been appointed master mechanic, succeeding S. R. Mathes. His headquarters are at New Bern, N. C.

L. M. Jones has been appointed assistant to general manager in charge of purchases, fuel and statistics, with office at Norfolk, Va. H. W. Davis, former purchasing agent, has been assigned to other duties and his office abolished.

Pan American.

D. Badilla has been appointed superintendent of motive power with office at Tonala, Mexico. He succeeds J. B. Cozart.

Pennsylvania.

C. H. Andras succeeds Joseph Davis as master mechanic at Harrisburg, Pa.

G. W. Butts succeeds A. W. Byron as assistant master mechanic at Altoona, Pa.

A. W. Byron has been promoted to master mechanic at So. Pittsburgh, Pa., succeeding M. A. Malley.

David J. Cloward, son of T. T. Cloward, general foreman of the Pennsylvania shops at Wilmington, Delaware, has been awarded the John Clark Sims Memorial Scholarship at the University of Pennsylvania. Two free scholarships at the University of Pennsylvania were established in 1909 by a committee appointed to found a memorial to the late John Clark Sims, formerly secretary of the Pennsylvania Railroad and for many years a trustee of the University of Pennsylvania. One of the scholarships is awarded by the trustees of the University, while the other is open on competitive examination, to employes or the sons of living or deceased employes of the Pennsylvania System, including its subsidiary lines.

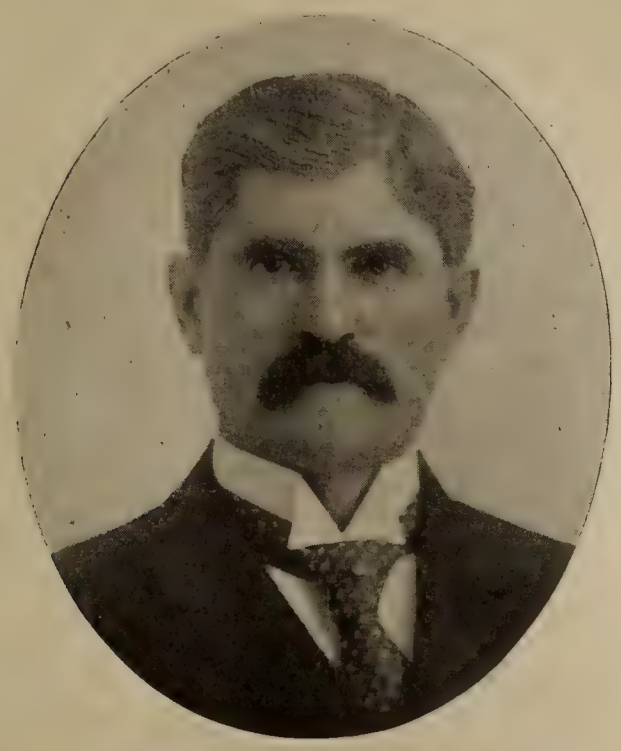
Pere Marquette.

Wm. Cotter, general manager of the Pere Marquette, has resigned.

J. E. Hickey has been appointed master mechanic with office at Grand Rapids, Mich. Mr. Hickey was formerly superintendent of motive power and equipment of the Mexico North Western at Madera, Chih., Mexico.

Pittsburg & Lake Erie.

W. T. Karnes succeeds M. A. Smith as foreman of locomotive repairs at Glassport, Pa.



W .E. Symons.

M. A. Smith, foreman of locomotive repairs, has been transferred from Glassport, Pa., to Youngstown, O.

Reid-Newfoundland Co.

Walter Ladley, formerly master mechanic of the Chicago & Alton at Bloomington, Ill., has been appointed superintendent of motive power of the Reid-Newfoundland Co., with office at St. Johns, N. F. Mr. Ladley served his time in the Port Huron shops of the Grand Trunk and shortly afterward was made shop foreman. Later he became master mechanic of the Central Vermont which position he resigned to enter the automobile field at Detroit, where he served as foreman and superintendent of different factories for four years. He subsequently accepted the position of master mechanic on the Alton, which he now resigns.

San Antonio & Aransas Pass.

W. E. Symons has been appointed superintendent of motive power with office at San Antonio, Tex., succeeding G. W. Taylor. Mr. Symons was at one time superintendent of motive power of the Chicago Great Western and until recently has been connected with the Chicago Association of Commerce Smoke Abatement Commission.

Seaboard Air Line.

J. W. Anderson has been appointed general car inspector, with office at Portsmouth, Va. He succeeds J. H. Howard.

Among The Manufacturers

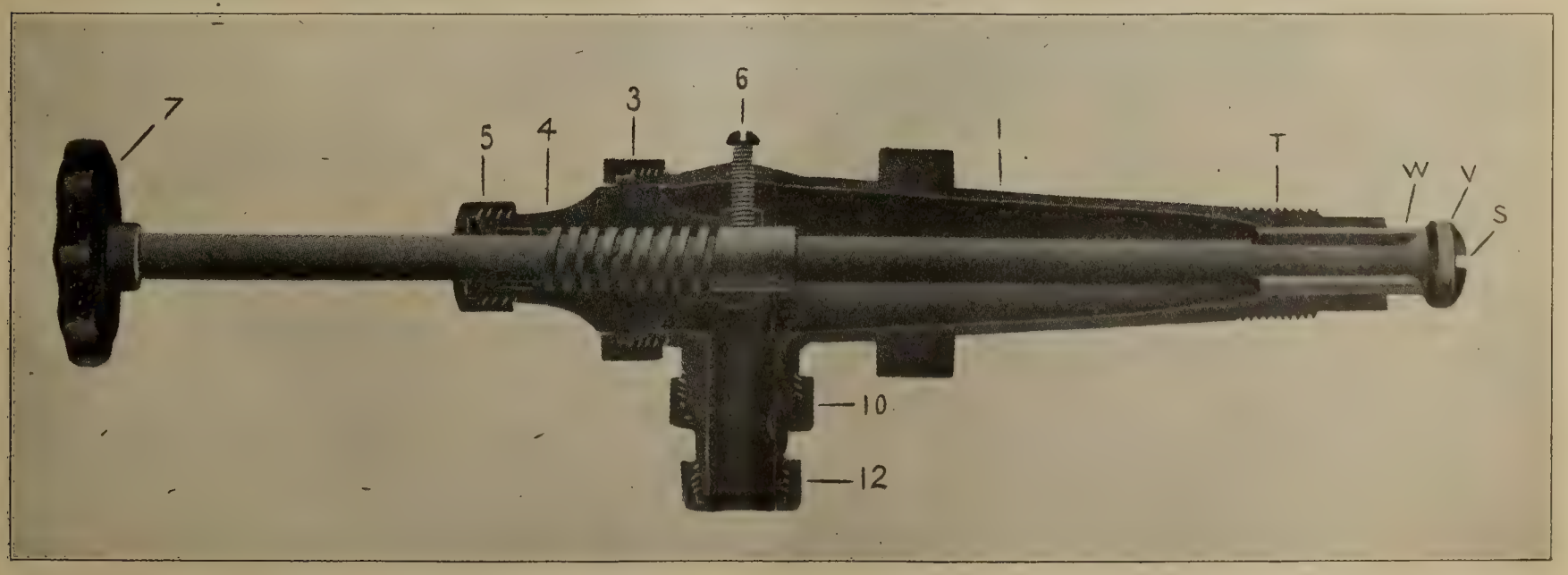
SECURITY GAGE COCK.

Low water is one of the principal causes of boiler explosions and the gage cock often has considerable to do with this condition of affairs. The "Security" gage cock by its construction affords protection against boiler explosions. It is impossible for scale or sediment to choke the passageway because each time the engineer tests the gage cock the cleaner wings (W) automatically loosen all accumulation. If it should become obstructed it can be cleaned under any pressure by detaching the hand wheel, packing-gland union and lonnet. A wire can then be inserted and the obstruction removed. The pressure, during this operation, holds the internal valve seated and there is an additional safeguard in the setscrew which holds the valve stem rigid. It has been cleaned under test in this manner under 190 pounds pressure.

The valve is also self-grinding and can be reground by removing the body from the boiler, screwing threaded end into a sleeve to prevent expansion of threaded end (T) and using a brace and screwdriver-bit in the slot S at the end (see illustration). The gage cock is very simple, having only five parts aside from the hand wheel. The water gage has an ingenious device which enables a broken gage glass to be replaced in a moment's time. This is done by unscrewing the two unions (10) which detaches the entire section. The new glass may then be inserted with ease. The "Security" gage cock and water gage is manufactured by the Security Gage Cock & Valve Co., of Portland, Ore.

TEN SPINDLE NUT TAPPER.

A new 1½-inch, ten-spindle, semi-automatic, nut-tapping machine has been placed on the market by the National Machinery Co. of Tiffin, Ohio. This tapper is on the same general lines as the one-inch, six-spindle, semi-automatic machine made by the same firm, although the present tapper embodies improvements and is equipped with a rapid change gear box, which enables changes to be effected in the revolutions of the tapping spindles, per raising and lowering, to correspond to the number of threads on the tap being used. Previously these changes were effected by removal and substitution of gears, which consumed



Security Gage Cock.

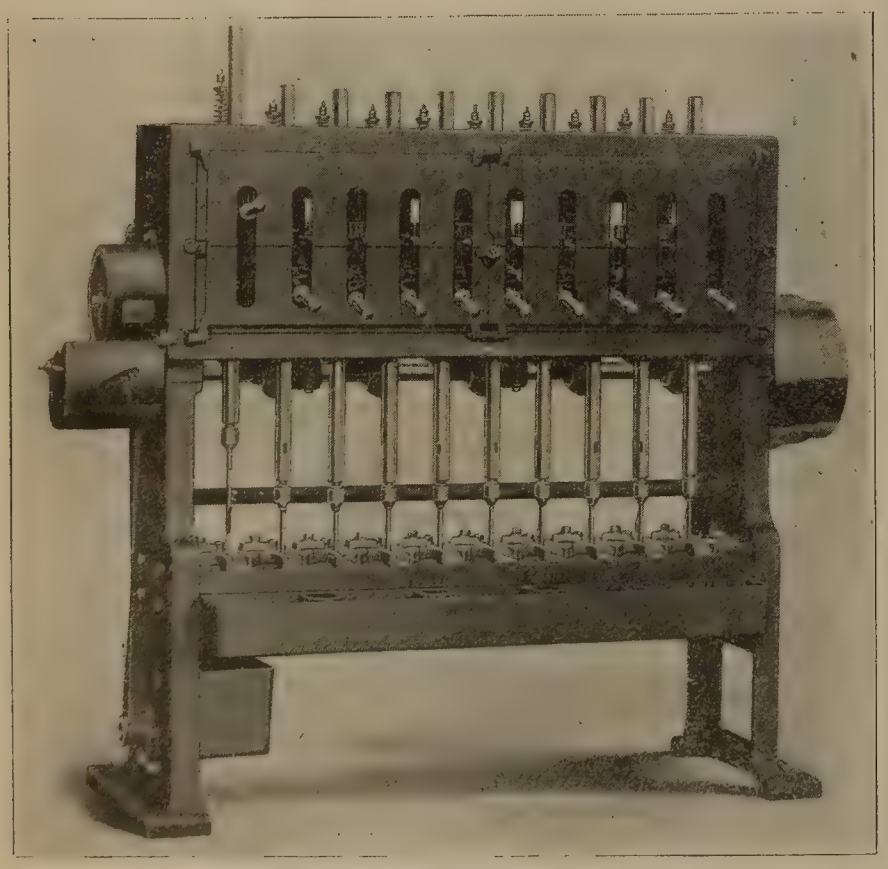
considerable of the operator's time and prompted to act against frequent change. With this rapid-change gear box the spindle revolutions can be altered by merely shifting a hand lever, and this can be done while the machine is running. The ease with which changes can be effected prompts the operator to reduce the spindle revolutions as the taps are ground, and the cutting teeth reduced in number, so that there is little or no idle tapping time—taps running free in the nut after it is tapped—which tends to insure maximum outputs.

In this semi-automatic type of tapper the spindles are raised and lowered by cams. Through this automatic spindle movement the machine "sets the pace" for operation, and the operator is relieved entirely from treadling, as on the "foot-lever" type of tapper, and consequently is not subjected to the attendant fatigue and can devote his entire energy to feeding. Exhaustive trials have demonstrated that operators have no trouble meeting the uniform pace set by the machine throughout a working day, and that on this machine it is possible to secure 60 to 80 per cent greater outputs than on foot-lever tappers.

The cams which raise and lower the spindles have three steps, and by shifting the cam shaft the resting time of the spindles when raised can be altered to meet the needs of the operator for feeding.

The spindles in this design are close together—the ten spindles being within a space of 69 inches—which is a decided advantage, as it facilitates feeding and enables the operator to successfully handle ten spindles without covering much floor space. The machine has sufficient range and power to tap two nuts of the smaller sizes on all spindles simultaneously, hence enabling outputs to be still further increased.

The nut holders on these machines are of novel and simple design. The nut guides are chilled plates of wedge shape, held in position by toe clamps. The guides are backed by stationary lugs of corresponding angle on the feed table, thus making the



National Ten-Spindle Nut Tapper.

guides extremely rigid; and insuring also parallel position of the guide faces as they are clamped rigidly against the stationary lugs. The guides have no tendency to shift or spring, and there is, hence, freedom from binding of the nuts when feeding.

Openings are provided in the nut pans through which the operator can empty the taps into boxes or kegs set beneath the tapper—out of the operator's way. It will handle either rough hot pressed or cold punched nuts.

New Literature

The Safety Heating and Lighting News, published by the Safety Car Heating & Lighting Co., New York, contains, in the December issue, a reprint of an article on "The Value of Illuminating Engineering to Society," by V. R. Lansingh. This was a paper delivered before the Illuminating Engineering Society.

* * *

The Atlas Ball Co., of Philadelphia, has issued a new book, which contains a complete description of the process of making Atlas balls, beginning with the importing of the chrome alloy steel, of which the balls are made, and ending with the final inspection and packing of the balls ready for shipment. It also gives a number of tables of ball data that will be found of use to engineers.

* * *

The Chicago Pneumatic Tool Co. has issued a number of bulletins dealing with the various types of electric drills manufactured by this firm, namely: Heavy duty drills for alternating current, Universal electric drills, operating on either direct or alternating current, and heavy duty drills for direct current. A new pamphlet on air receiver, aftercoolers, traps, heaters and economizer has also been issued.

* * *

The Moore Patent Car Co., of St. Paul, Minn., has issued supplement number 3 to its regular catalogue. It contains some interesting figures and illustrations of the Moore patent system of car refrigeration, heating and ventilation. The Soo Line has just completed 300 Moore heater cars.

Industrial Notes

The Gould Coupler Co. will soon have its executive offices located on the seventh floor of the new 20-story building that is being erected on Madison avenue between Forty-first and Forty-second streets in New York City.

F. M. Whyte has been elected vice-president of the Hutchins Car Roofing Company, with office at New York. The U. S. Metal & Mfg. Co. are the Eastern representatives of this company, and the Spencer Otis Company the Western representatives.

J. E. Chisholm, 350 Old Colony Building, Chicago, Ill., and George R. Argo, Third National Bank Building, Atlanta, Ga., have recently been appointed representatives of the Universal Flexible Packing Company of Pittsburgh. This company makes a specialty of locomotive air pump packing (metallic) of a very simple constructive type.

J. P. Moore formerly of the Wyandotte Construction Co., Kansas City, Mo., has accepted a position with the engineering department of the Westinghouse Electric and Manufacturing Co., and will be engaged in railway electrification work.

Mr. Moore has had a wide experience in railway construction work, having been engaged for some time past with the above company, in the construction of the 70-mile, 1,200-volt direct current line of the Kansas City, Clay County & St. Joseph Ry. For five years he was connected with the General Electric Co. in general engineering work and subsequently with the Pacific Light and Power Co. as resident engineer; and with the Des Moines Edison Light Company as superintendent of distribution, having charge of extensive improvements for these companies. He has also done considerable work for a number of traction companies in the middle west. He was instructor in electric railway engi-

neering at State College, Pennsylvania, and while there contributed quite extensively to the technical press.

J. B. Ennis is appointed chief mechanical engineer of the American Locomotive Co. with headquarters at New York. He will perform the duties formerly assigned to the vice-president in charge of engineering, except that the chief engineer will report directly to the president on construction and shop engineering matters.

W. P. Steele is appointed assistant to the president of the American Locomotive Co., and will perform the duties heretofore assigned to him, and such other duties as may be assigned to him by the president.

Samuel E. Barrett, president of the Barrett Manufacturing Co., Chicago, with office in that city, died on December 29, 1912, at the Johns Hopkins Hospital, Baltimore, Md.

The Bucyrus Co., Milwaukee, Wis., has moved its New York office from 50 Church street, to 30 Church street. This office is in charge of C. S. Reed, eastern sales manager.

The Dressel Railway Lamp Works, New York, has discontinued its office in the Peoples Gas Bldg., Chicago.

The Oxweld Acetylene Co., Chicago, Ill., with plants at East Chicago and in the East, is about to build a plant at Detroit, Mich., for which an expenditure of $500,000 is contemplated.

The Allis-Chalmers Co. has been awarded a contract by the city of Cleveland, O., for three Allis-Chalmers steam turbines and alternating current generators, each rated at 5,000 K. W., for the municipal lighting plant.

The Hart-Hutchinson Mfg. Co. has secured an option on about 45 acres of land fronting on the tracks of the New York, New Haven & Hartford, New Britain, and if the transaction is completed, plans to erect a manufacturing plant on the property. The buildings will probably be one story in height and about 600 ft. in length. The company recently purchased the locker manufacturing rights from the Hart & Cooley Mfg. Co.

The H. W. Johns-Manville Co. has moved its San Francisco offices from New Montgomery and Natoma streets to the corner of Second and Howard streets.

The Pacific Coast Collieries Co., Ltd., has been formed with a capital of $3,500,000 of bonds, $1,500,000 of 6 per cent preferred stock, and $3,500,000 of common stock and has taken over the Pacific Coast Coal Mines, Ltd.

Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until January 25, 1913, for three steel oil storage tanks at the Naval Station, Pearl Harbor, Hawaii. Estimated cost, $56,000. Plans and specifications can be obtained on application to the Bureau.

A. H. Framhein, who has been connected with the Chicago sales department of the Railway Steel-Spring Co. for about five years, has resigned, effective January 1, to introduce in that city "Latheroil" cleaning products, manufactured by the Heinrich Fischer Co. of Cincinnati. Mr. Framhein will be located at 440 Marquette building, Chicago, Ill.

The Wheeler Condenser & Engineering Co., Carteret, N. J., manufacturers of high vacuum surface and jet condensers and general condensing machinery, has established an office at 1325 Citizens' Building, Cleveland, O.

A. E. Crone, formerly storekeeper of the New York Central & Hudson River at Depew, N. Y., has been appointed supply agent of the Buffalo Brake Beam Co., at Buffalo, N. Y.

The Joseph Dixon Crucible Co., of Jersey City, N. J., announces that it has reduced the selling price of the silica graphite paint.

The firm name of the Dearborn Drug & Chemical Works has been changed to the Dearborn Chemical Company. The general offices of the Dearborn Chemical Company are in the McCormick Bldg., Chicago.

The McKeen Motor Car Co., of Omaha, Neb., has just received an order for two 70 foot gasoline motor cars from the Port Huron & Northern Railway, a Michigan road.

L. H. Mesker, manager of the St. Louis branch of Manning, Maxwell & Moore, has resigned his position and will assume a similar position with the Ferro Machine & Foundry Co., Cleveland, O., after January 1.

The Oxwell Acetylene Co. has moved its general office from the Peoples Gas building, Chicago, Ill., to the new works at Thirty-sixth street and Jasper place.

The Scallan Supply Co., 122 West Second street, Cincinnati, O., has been recently incorporated. It will handle mine and railroad supplies.

To provide for additional space and facilities in connection with the production of portable electrically operated drills and reamers, the Van Dorn & Dutton Co., of Cleveland, O., has disposed of its electric department in which were produced armature, field and induction motor coils relating to motors for railway and mill service. The facilities pertaining to motor repairs, armature, field and induction motor coils have been taken over by the Cleveland Coil & Mfg. Co., of Cleveland, O. The added space secured has enabled The Van Dorn & Dutton Co. to add materially to its facilities for machine operations, as well as the assembly and engineering departments.

The Ward Equipment Co. has changed its name to the Standard Heat & Ventilation Co., Inc. The offices remain at 141 Cedar St., New York, as heretofore.

S. W. Midgley.

S. W. Midgley, formerly western representative of the Curtain Supply Co., has been appointed western sales manager, with office at 320 West Ohio street, Chicago.

The Gordon primary battery business heretofore operated by The Lutz-Lockwood Mfg. Co., is now conducted by the Gordon Primary Battery Co., 50 Church St., New York.

G. A. Nelson, General Manager, W. M. Kinch, Signal Engineer, W. Dodd, New York, and O. S. Flath, Chicago will continue to look after the interests and requirements of the trade. As will be noted there has been no change in the aforementioned organization, and the new title of Gordon Primary Battery Co., has been adopted as at once suggesting itself to battery users as manufacturers of Gordon cells.

William Miller, president of the Monarch Pneumatic Tool Company, has resigned his position, effective December 31st and has accepted the Vice-Presidency of the Pyle-National Electric Headlight Company, with offices at the Karpen Building, Chicago.

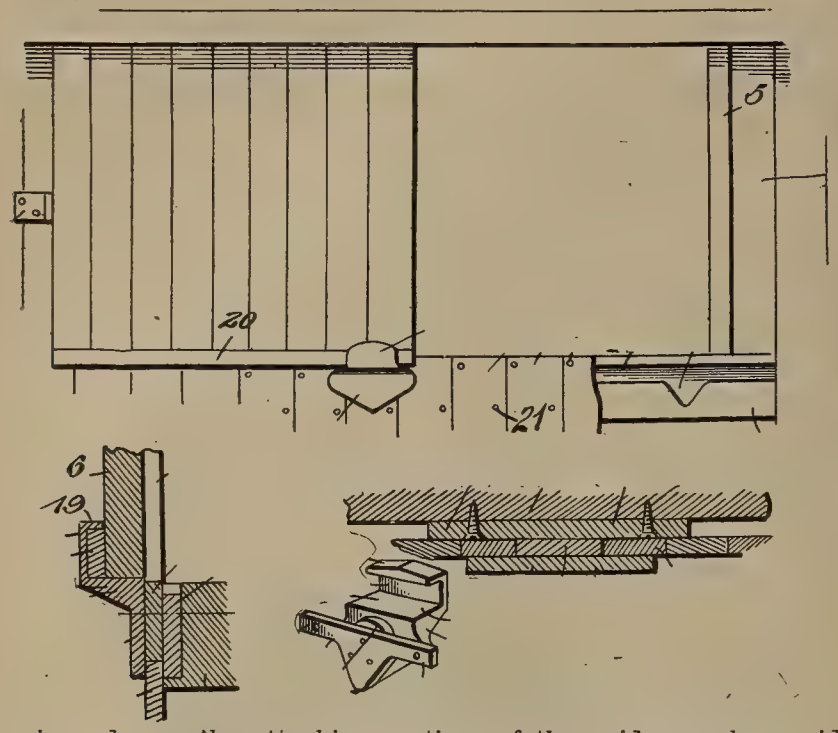
Recent Railway Mechanical Patents

CAR-DOOR GUIDE.

1,045,888—John Rinehart, Seymour, Ind.

This invention relates to an improved guide for sliding car doors and has for its object to provide a device of this character and means for attaching the same to the sill of the car body whereby access to the guide fastening screws is prevented so that the guide cannot be removed and the car door opened. Another object of the invention is to provide a guide member for sliding car doors having an attaching portion, the sill of the car body being recessed to receive said attaching portion to be secured therein by means of suitable fastening screws, facing boards constituting the side of the car adapted to be secured to the sill over the recess

1,045,888.



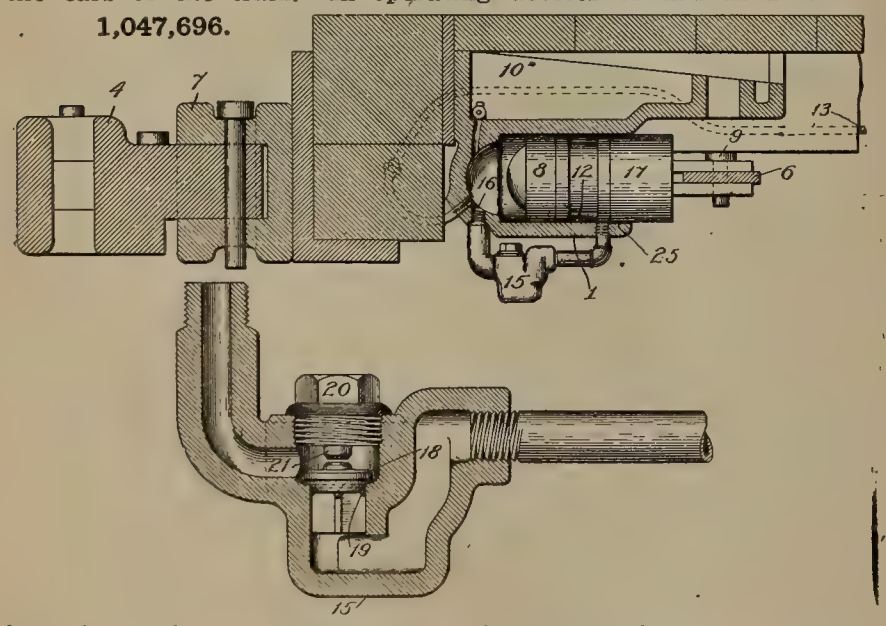
therein and over the attaching portions of the guide member, said guide member being provided with a stop flange with which a rib on the lower edge of the door is adapted to coact to prevent the door being lifted and moved to its open position. Still another object of the invention is to provide a device of the above character which is simple in construction may be inexpensively manufactured, and is strong, durable and efficient in practical use.

LOCOMOTIVE-DYNAMOMETER.

1,047,696—John E. Phillips and Samuel T. Park, Danville, Ill.

This invention is an improvement in locomotive dynamometers of the form in which the tractive force exerted by the locomotive is indicated and recorded by means of the pressure imposed upon a liquid, such as oil, contained in a cylinder secured to the locomotive or tender and acted upon by a plunger secured to one of the cars of the train. In operating devices of this kind it has

1,047,696.



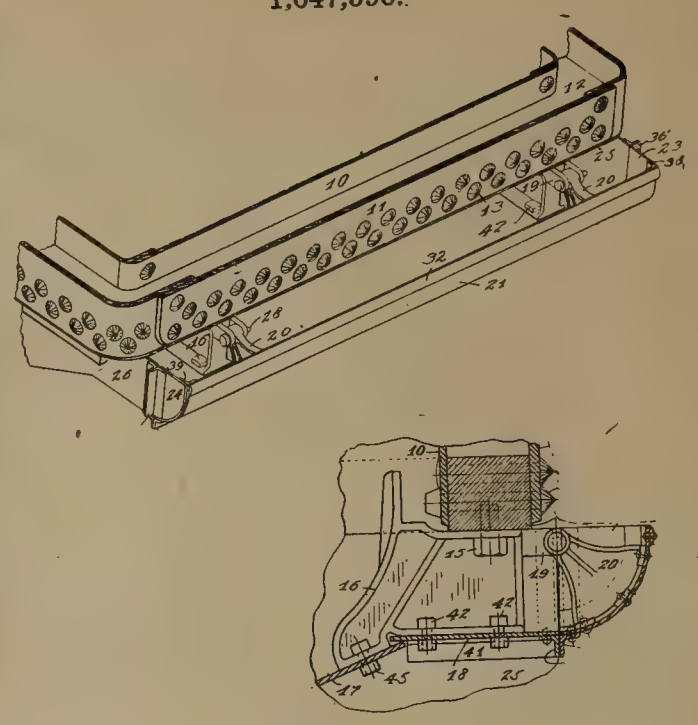
been found that a certain amount of oil passes between the plunger packing and the walls of the cylinder, resulting not only in the loss of oil but also, when the leakage has proceeded far enough, interfering with the proper action of the apparatus. The object of this invention is to restore the liquid which passes between the plunger packing and the walls of the cylinder to operative position inside of the cylinder, and to keep the cylinder supplied with oil.

AIR-ADMISSION DEVICE.

1,047,590—John G. Talmage, Cleveland, O.

One of the objects of this invention is to provide effective means for enabling the admission of air to a locomotive firebox from the sides of the locomotive in such a way as will not allow the hot coals to drop out at the side of the ash pan. Another object is to enable the convenient cleaning of the side portions of the ash pan where material is liable to clog. Still another object is to provide for convenient calking of the mud ring. In accomplishing

1,047,590.



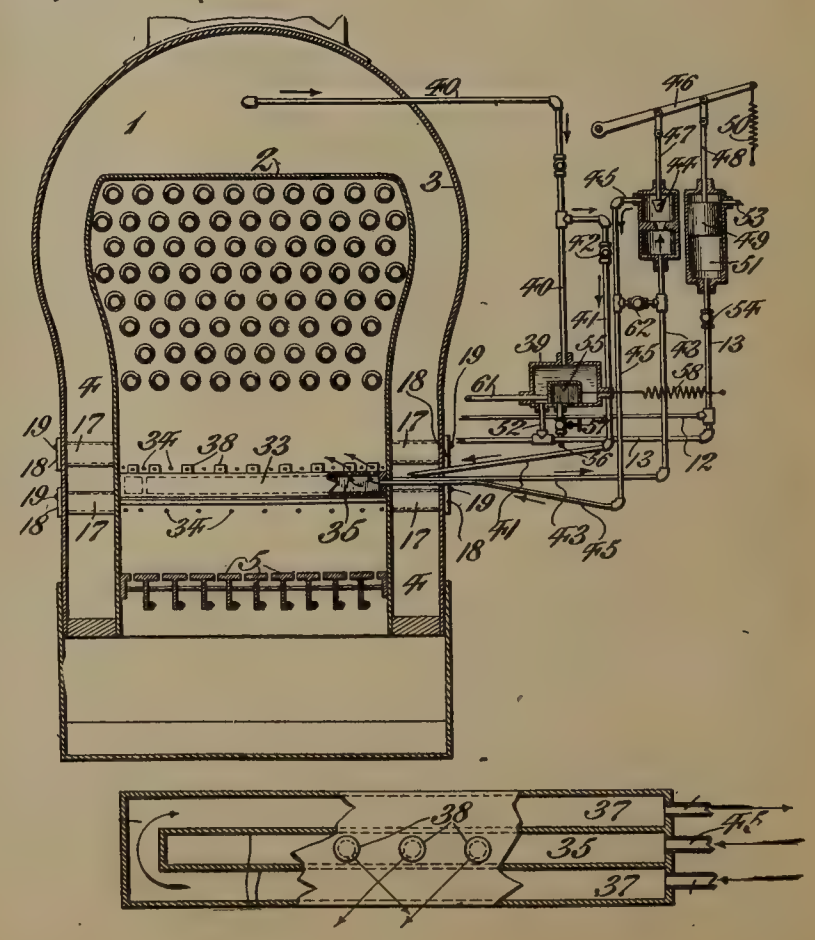
the desired result an air space is provided beneath the mud ring leading to the top of the ash pan adjacent to the under side of the grate, and at the outer side of this air space is mounted a concave, upwardly extending deflector. This deflector is open above so that there is a convenient air passageway to the grate, while the deflector prevents any hot coals dropping out; it also gives a neater appearance to the locomotive by preventing the hot coals in the ash pan being ordinarily visible from the outside. By having this deflector pivotally mounted, it may be swung upward on its pivots to enable access to the ash pan for cleaning its outer portions, where material is liable to clog. The bottom plates supported by the brackets and defining the air space are made removable to enable access to the mud ring for calking. The same brackets are used for holding not only the deflector and the bottom plate referred to, but also the outer portion of the ash pan and the grate itself. All these features will be hereinafter more fully described.

LOCOMOTIVE FURNACE.

1,046,583—Daniel Goff, Millville, N. J.

This invention relates to a new and useful induced draft and smoke consumer for use in connection with a locomotive type of boiler. It has for an object to provide a construction whereby steam and air may be introduced in suitable quantities into the firebox at an advantageous point to cause a more complete combustion of the fuel products and serve as an efficient draft producing means. The introduction of the steam and air is regulated by a suitable apparatus which may be controlled either manually or automatically, whereby the quantities of the mixture may be proportioned properly to produce the desired combustion.

1,046,583.



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CLEANING SUPERHEATER TUBES.

During the discussion of a paper on the subject of superheated steam, recently given before the Western Railway Club, the importance of keeping superheater tubes in good condition was emphasized. As was stated in the paper, the large superheater flues constitute a considerable percentage of the water heating surface in a locomotive equipped with a superheater, and any stoppage in them not only affects the water heating surface but also cuts deeply into the efficiency of the superheater units. That is, it is double acting, working at the same time against both the superheater and the steaming qualities of the engine. The installation of the superheater, in its most efficient form, is such as to naturally tend towards clogging of the tubes, and although future developments may modify this design to a certain extent, the condition is with us now and must be handled in the most satisfactory manner possible.

Mr. Bourne, of the Locomotive Superheater Co., made a very strong point in saying that the flue cleaning question is *always* a vital one whether it be in the saturated steam locomotive or the superheater locomotive, and that the superheater often is blamed when a condition of the superheater tubes exists which would not be tolerated with the ordinary tubes. The thorough cleaning of boiler tubes is, beyond doubt, of vital importance, for on it depends the primary function of the boiler, namely, the transference of heat from the gases to the water. The medium at best is poor, but when it is allowed to become coated and incrusted with a poor conductor of heat the loss is great. Now, this is nothing new and startling; every mechanical man knows it, but in the efforts to keep the locomotive in service it is often lost sight of. And that brings it down to that much abused man, the roundhouse foreman. He is the man who knows whether the tubes are being cleaned and who can exert a great deal of influence in determining the efficiency of the engine. Often, however, he is blamed for a poor condition of the engines which cannot be helped, for often the force and time are too limited to give the engine anything more than a superficial cleaning. A member mentioned one instance of where 140 locomotives were handled per day at a certain point and where it could not be expected that the condition of the tubes would be looked into very thoroughly.

With such conditions common with the saturated steam engine, how much more important it is that they be overcome on superheaters. The superheater people have had their troubles, many of which have happily been eliminated. However, probably their greatest one has been due to inefficient flue cleaning. In fairness to all, it may be said that the officers of many roads expected that all they had to do was to install superheaters and forget about them, at the same time expecting a greatly increased efficiency. Any new device installed on a locomotive adds to its complications and must be given careful attention if it is to prove itself of value. Of nothing is this more true than of the superheater units, installed as they are, in the vital part of the boiler.

The superheater is proving its efficiency, but if it is to give a good account of itself it must be given a chance. As was aptly stated by one man at the meeting: "You can't walk into a firebox, look around, and walk out again." You can't

look at an engine and determine that her flues need cleaning. It does not take so much science but it does take hard, consciencious work at frequent intervals. If they are allowed to get so bad that some of the units have to be pulled out, it inevitably results in springing and distorting them and the superheater receives the blame. If the roundhouse hasn't enough men to take care of the tubes properly, put on more. If the roundhouse foreman is slighting the work, get a new foreman. The superheater is worthy of good care.

Periods of cleaning vary greatly on different roads and are greatly influenced by the grade of coal used. If the use of the best coal available is an economy with saturated steam engines, then most certainly it is with the superheater. An interesting feature of cleaning tubes on the North Western was mentioned by Mr. Pratt. He stated that they had furnished pocket flash lamps to the flue cleaners which enabled them to see the whole length of the tube and thus to determine for themselves if they were doing effective work. These flash lamps, if used, ought to do a great deal towards keeping superheater tubes in proper condition. Everything that can be said about keeping ordinary boiler tubes clean should be multiplied by two for superheater tubes.

QUICK ACTION FORGING PRESSES.

The railway forge shop has been so long dependent upon the steam hammer for all forgings that other methods of doing the same work with greater efficiency in certain cases seem not to have been given proper consideration. The press, in so far as it has been used in railway blacksmith, boiler or forge shops, is looked upon as a species of apparatus only applicable to the forming of sheet steel, boiler heads and other boiler appurtences and for the purpose of doing multiple punching on a large scale. It is probable, however, that the quick action combination steam and hydraulic press will, when its merits are given full consideration, supersede the steam hammer, at least in such shops as those which are large enough to include both hammers and presses in the equipment.

The principle of the quick action forging press, while it is adapted to perform a great many of the operations for which the hammers are now used, is quite different from that of the steam hammer. The press, while delivering strokes less rapidly than the hammer, does not depend upon inertia of moving parts, but pressure, limited only by the capacity of the press in use, is exerted on the forging in such a way that the mass of steel is treated throughout its complete section, whereas it is well known that hammer action results in more or less of surface treatment according to the skill of the operatives. The steam-hydraulic press cannot, of course, be substituted for the hammer in all forge shop operations. Its adaptability, however, ranges through such a large number of these operations that a shop which is laid out for four hammers could probably be operated much more efficiently with two hammers and a press. The elimination of one unit is made possible by the extreme rapidity with which work can be turned out on the latter.

This is due in part to the fact that material can be further progressed with one heat than would often times be possible in the case of the hammer with several heats. The increased efficiency of the press is, therefore, dependent both upon its greater rapidity of operation and the better quality of the work turned out. A popular fallacy credits the press with requiring more floor space and head room than does the hammer. This is not based on fact, as inspection of several makes of quick action steam hydraulic presses will reveal. Another advantage claimed by the exponents of the press, and one which is of more or less importance according to the location of the shop, is the elimination of the hammer noise, the press operating very quietly. We believe that a complete consideration of the merits of the forging press will result in its installation in the larger railway shops as a necessity for more efficient forging apparatus develops.

LOW GRADE COAL.

One of the subjects to be discussed before The International Railway Fuel Association at its May convention is "Sub-bituminous and Lignite Coal as a Locomotive Fuel." This is a subject which has not had a prominent place in club and convention programs, and as it is one of growing importance, its study and discussion should be of value to every railway man. It is characteristic of our national growth that we have been wasteful of our resources, and during the past few years we have begun to realize that our extravagance must be curbed; hence the movement towards conservation in water power, in our forests and indeed in human life.

Among our most important primary sources of power are coal, oil, wood and water. Wood as a source of power is almost negligible, as we have found that we cannot afford to use it. The possibilities of water as a source of power are just beginning to be touched, and it seems that the future will show great developments in its use, for it is the only source which apparently is endless. But the range of the transmission of hydro-electric power is at present limited and is not feasible for trans-continental operation of railways, so the general operation of our railways for some time will be dependent on coal and oil. Oil has never come into very extended use on American railways, there being at present approximately 4,000 engines, out of a total of 60,000, equipped for burning oil. Those roads whose lines lie in the oil field can use it very advantageously, but the present upward tendency in price of oil is making it prohibitive in some sections. This increase in the cost of oil may be expected to continue, due to the growth in use of gasoline-propelled vehicles. However, the quantity of *oil* consumed by the railways of this country in 1910 was 24,586,108 barrels; including, of course, oil used for shop purposes.

The railways of this country must look to coal as a source of power for some time to come. The production of the better grades of coal at present shows no signs of falling off, but the quantity used is tremendous. Great pressure is being brought on our railways today to bring about higher efficiencies —their incomes are practically fixed and the only way left to earn their dividends is to cut down costs.

There are fields of low grade coal scattered over this country, which we have not thought worth the effort to use it in our locomotives. It is true that efforts have been made along this line, but they have not gone very far for the reason that there did not seem to be any necessity for it. One road in the

Northwest has been using lignite quite successfully, and almost as efficiently as the better grades of coal, but in general no special efforts have been made to burn these poorer grades of coal. There is a field for investigation and study here; better methods of utilizing the lower grades of coal can be brought out, once the necessity for it and the saving possible is demonstrated. The report on these coals before the Fuel Association is timely and should bring out interesting and valuable information.

LOCOMOTIVE DRIVING BOX TROUBLES.

It has been noted by certain men responsible for the operation of large numbers of locomotives some of which are equipped with Taylor iron axles that there is frequently a difference between the running qualities of the steel and iron axles so far as journal conditions are concerned. It was found that the arrangement of driving box brasses which proved successful for steel axles would run hot on the iron axles. An arrangement which was found by George J. Hatz of the Union Pacific, to work successfully on both classes of journals involved the elimination of all lubrication distribution slots in the brasses with the exception of one deep slot across the width of the brass (stopping it at points a short distance from each end of the latter) at its highest point. Dove-tailed slots were, however, chipped out on each side of each brass on a line midway between crown and journal center. These dove-tailed slots were filled with babbitt. The explanation of the action of the babbitt metal in keeping the journal cool was not forthcoming. Sufficient lubrication distribution was, however, effected through the one large slot above the journal. Incidentally this furnished an easy means of conveying lubricant to the hub face, thus cutting down lateral wear. To effect this the end of the brass was drilled with a small bit in such a way as to tap into the grease filled slot and the oozing of grease under pressure formed a simple means to the end in view.

OPEN CAR SHOPS or repair tracks have their disadvantages, resulting from the loss of time during periods of bad weather. At a recent meeting of a railway club, a member mentioned an instance of where a total of 10,800 hours was lost in four days at a certain point on account of bad weather.

* * *

THE NEXT CONVENTION of the International Railway General Foremen's Association will be held at the Hotel Sherman, Chicago, Ill., on July 15, 16, 17 and 18, 1913.

* * *

DO YOU THINK the double-ended car shop has any advantage over the single-ended shop? One of the arguments for the single-ended shop is that storage space for materials must be provided and that it is more accessible with such a shop. It is said that some double-ended shops are using but one end.

* * *

CAST STEEL and forged steel packing rings are being used successfully on a number of engines equipped with superheaters on the Chicago & North Western Ry. This road has also been experimenting with brass packing rings

CAR EFFICIENCY.

An address on the above subject was given before the Traffic Club, of Chicago, on Jan. 8, by J. M. Daly, superintendent of transportation of the Illinois Central. Among other things he stated that the time may come when railways will have to pool their freight cars so that the car supply may be handled more efficiently and the amount of empty movement be decreased. The following are other portions of Mr. Daly's address:

Car efficiency is wholly dependent upon terminal, track facilities, ample team tracks and an adequate supply of locomotives to permit of prompt movement of the cars. It also depends upon the co-operation of the shipper and the consignee in the prompt loading and unloading. The records during the last three months on 80 per cent of the railroads show that they had about all the cars that could be handled to advantage either for want of additional yard and terminal tracks or for want of additional engines to move them, and, in my judgment, had such railroads been able to secure all of the cars ordered as required for loading it would have created a serious congestion which would have resulted in the railroads moving considerably less traffic than they actually handled.

A transfer company in the city would not buy a lot of wagons until after they had provided themselves with a yard in which to put the wagons, with teams to move the wagons and with stables in which to house their horses. The same condition is true with the railroad. It is necessary first to provide facilities to promptly handle the cars on, then provide engines to move them, then shops and roundhouses to take care of the engines, the last purchase being the cars; but it must be admitted that it requires an enormous amount of capital to purchase valuable grounds for yards, team tracks and shops, and also to provide for locomotives and cars.

Car efficiency on one railroad is to a large extent dependent upon the conditions existing on other railroads; for example, if the lines east of Buffalo and Pittsburgh congest, the effect of that congestion backs up to Chicago and even as far as Kansas City and Omaha, by reason of each road refusing to accept cars loaded for points within the congested zone east of Buffalo or Pittsburgh. This necessitates holding the cars on valuable terminals to wait until this congestion is lifted and cars can be sent forward.

Another factor that affects car efficiency on the road owning the cars is the factor of confiscation and misuse of its equipment by another road that is not fully equipped with cars. This condition affects more especially the roads that originate traffic such as grain, lumber, coal, cotton and other commodities that must necessarily find a portion of its market on the tracks of other railroads.

The railroads feel that the action taken by the Traffic Club of Chicago, the Commerce Association, the Manufacturers' Association, the different railroad commissions and the Interstate Commerce Commission in requesting hearty co-operation of the shippers and consignees in the prompt loading and unloading of cars on account of the enormous tonnage to be moved this winter, has had a very material effect in creating a better movement, but we feel that there is still considerable room for improvement. I realize the enormous outlay of money that is necessary on the part of the roads to provide tracks, engines and cars and for the consignees to provide themselves with ample storage facilities to carry a reasonable supply of raw materials instead of living from day to day on the traffic from the cars to the plant.

It is extremely gratifying to know the disposition on the part of both shippers and the railroads to get together closer, this more especially in the last year, and the result of this co-operation is sure to result to the benefit of both.

Fuel Tests, Chicago & North Western Ry.

The lines of the Chicago & North-Western Ry. are divided for operating purposes into Lines East of the Missouri River and Lines West of the Missouri River. The Lines West cover the states of South Dakota, Nebraska and Wyoming, and embrace the main lines to the Black Hills and to the western terminus at Lander, Wyoming. About six years ago, the North-Western equipped one engine for oil burning and the number has gradually been added to, until last year it had 25 oil burners in service on the Lines West. As it runs through the oil fields of Wyoming, it has been enabled to use oil very advantageously, the oil being received direct from the refineries at Casper, Wyoming, into the company's tank cars and then being transported to tanks at Chadron and Long Pine, Nebraska, having capacities of 5,000 barrels each.

In addition to oil, the North-Western also uses lignite on the Lines West, as it is quite plentiful in this territory, the source of supply being the mines at Hudson, Wyoming. The bituminous coal used comes from Buxton, Iowa. So during the past few years, the three fuels, oil, lignite and bituminous coal, have been in use in the western territory. While the nearness to the source of supply, effected, to a large extent, the economy with which these different fuels could be used, it was quite evident that a test would be the only sure method of determining which of them could be used most efficiently. Mr. F. Walters, general manager of the Lines West, at Omaha, made a number of rough tests a year or two ago and the results seemed to point to one fuel so decidedly, that it was decided by the mechanical department of the North-Western to make a careful and complete test of the fuels with a view of adopting that which proved the more economical, for general use in Wyoming, Nebraska and South Dakota.

These tests were run during the months of May and July, 1912, under the supervision of J. C. Little, mechanical engineer. They were made between Chadron and Long Pine, Nebraska, a distance of 192 miles, and as has been noted, the points at which oil storage tanks are located. The railway company's dynamometer car was used, being attached to the regular passenger trains and to extra freight trains, as the tests were made to cover both passenger and freight service. The data was taken by four of the company's apprentices, three being located in the dynamometer car and one on the engine. Preparatory to starting the tests, the oil and water tanks were leveled up and calibrated in units of gallons, this being measured on the rod in the case of the oil tanks. The usual method of dumping in a barrel of fluid and making a corresponding measurement, was followed. In taking readings of the water during the tests, two were taken, at diagonally opposite corners, in order to obtain a fair average. All coal was weighed on the tender and weighed off, and at points where coal was taken on, it was weighed into the chutes. The tests were started when the train pulled out of the yards (in freight service) and when the train pulled out of the depot (in passenger service). In order that the weighed coal might not be disturbed until the test was actually under way, a number of sacks of coal were carried for use in getting out of the roundhouse, etc. It should be mentioned here that although a number of different engines were used, it was found expedient to use the same tanks on the different engines; that is but one tank was used in the tests of oil burning engines and one tank with the coal burning engines.

Train No. 6, east bound, carried a mail coach, baggage coach, smoker, day coach and one sleeper, and train No. 3, west bound, was the same, with the exception that two sleepers were carried. Thus the east bound was a five coach train and the west bound a six coach train. The number of passengers were counted in each test and the car weights, of course, were known. The weights of the freight trains were obtained in the usual manner. The regular engine crews were used, except that it was arranged to have the same crew which had taken an engine west, turn about and take it east again, in order to insure more uniform results.

The engines used in the test are what is known as class Q and class L; class Q being a ten-wheel engine burning oil and bituminous coal, and the class L a Pacific, burning lignite. Some of the statistics with regard to these two types are as follows:

	Class Q.	Class L.
Tractive power	21,600 lbs.	22,450 lbs.
Factor of adhesion	5.03	4.92
Water capacity of tender	4,000 gals.	7,500 gals.
Coal capacity of tender	10 tons	10 tons
Steam pressure	190 lbs.	160 lbs.
Firebox, length inside	90⅛ lbs.	102¾ lbs.
Firebox, width inside	40¼ lbs.	65¼ lbs.
Tubes—		
Number	229	271
Length	141 ft. 2 ins.	18 ft. 0 ins.
Diameter	2 ins.	2 ins.
Heating Surface—		
Tubes	1,688.65 sq. ft.	2,542.30 sq. ft.
Arch tubes	11.81 sq. ft.	
Firebox	145.80 sq. ft.	177.40 sq. ft.
Total	1,846.26 sq. ft.	2,719.70 sq. ft.
Grate area	25.36 sq. ft.	46.55 sq. ft.
Weight on drivers, loaded	108,575 lbs.	110,500 lbs.
Weight of engine	147,560 lbs.	180,000 lbs.
Weight of tender	91,600 lbs.	144,300 lbs.

The oil used was that supplied by the Mid-West Oil Co., and out of which everything down to and including kerosene, had been taken out. Its average properties are as follows:

Gravity .....29° Baume
Flash point .....160°

The bituminous coal was storage coal, with the following analysis:

Volatile combustible matter 40.48%
Fixed carbon 39.10%
Moisture 10.51%
Ash 9.91%
Sulphur (separate determination) 2.91%

The lignite analyzed as follows:

Volatile combustible matter 38.65%
Fixed carbon 37.72%
Moisture 2.21%
Ash 21.41%
Sulpher (separate determination) 4,24%

Five sets of tests were conducted—on lignite, on oil and on bituminous coal in freight service, and on oil and bituminous coal in passenger service. Tests were made on two different engines for each set and for each engine two tests were made running east and two running west. This resulted in eight separate tests in each set. The averages of all were taken and the results of the average are given in the tables on the succeeding pages.

The averages given in the tables are the averages of two

FREIGHT SERVICE

CHADRON-LONG PINE-EAST- LIGNITE BURNER (CLASS-L-) EXTRA FREIGHT

1912	Time-Hours Elapsed	Time-Hours Running	Avg. Temp. Atmo.	Tonnage Chadron-Hay Sprgs	Tonnage Hay Spg's Long Pine	Mileage Chadron Hay Spgs	Mileage Hay Sp'gs Long Pine	Mileage Total	Coal Used Tons	Coal Used-Pounds Per Hour	Coal Used-Pounds Per Horse Power Hour	Water Used-Gallons	Water Used-Lbs Per Hour	Water Used-Lbs Per Horse Power Hour	Ton-Miles-Per Pound Coal	Ton-Miles-Per Gallon Water	Average Draw Bar Pull Pounds	Maximum Draw Bar Pull Pounds	Work Done Horse Power Per Hour	No. Cars in Train Chadron-Hay Springs Empty	Chadron-Hay Springs Load	Chadron-Hay Springs Total	Hay Springs Long Pine Empty	Hay Springs Long Pine Load	Hay Springs Long Pine Total
Avg.	10.5927	8.3032	62.01	580.938	775.98	19.63	172.18	191.80	17.017	4091.303	14.767	19575.00	19548.244	70.436	4.3330	7.5890	4547.82	17375	279.10	22.3	7	29.3	1.5	3.5	5

LONG PINE-CHADRON-WEST- LIGNITE BURNER (CLASS-L-) EXTRA FREIGHT

1912	Time-Hours Elapsed	Time-Hours Running	Avg. Temp. Atmo.	Tonnage	Mileage	Coal Used Tons	Coal Used-Pounds Per Hour	Coal Used-Pounds Per Horse Power Hour	Water Used-Gallons	Water Used-Lbs Per Hour	Water Used-Lbs Per Horse Power Hour	Ton-Miles-Per Pound Coal	Ton-Miles-Per Gallon Water	Average Draw Bar Pull Pounds	Maximum Draw Bar Pull Pounds	Work Done Horse Power Per Hour	No. Cars in Train Long Pine Chadron Empty	Long Pine Chadron Load	Long Pine Chadron Total
Avg.	10.4886	8.7844	67.83	588.90	192.54	19.363	4390.985	14.201	21840.63	20736.157	66.940	2.9997	5.2312	5368.65	17125	312.72	10.5	11	21.5

CHADRON-LONG PINE-EAST- BITUMINOUS COAL (CLASS-Q-) EXTRA FREIGHT

1912	Time-Hours Elapsed	Time-Hours Running	Avg. Temp. Atmo.	Tonnage Chadron Hay Sprgs	Tonnage Hay Sp'gs Long Pine	Mileage Chadron Hay Spgs	Mileage Hay Sp'gs Long Pine	Mileage Total	Coal Used Tons	Coal Used-Lbs. Per Hour	Coal Used-Lbs. Per Horse Power Hour	Water Used-Gallons	Water Used-Lbs. Per Hour	Water Used-Lbs. Per Horse Power Hour	Ton-Miles-Per Pound Coal	Ton-Miles-Per Gallon Water	Average Draw Bar Pull Pounds	Maximum Draw Bar Pull Pounds	Work Done Horse Power Per Hour	No. Cars in Train Chadron-Hay Springs Empty	Chadron-Hay Springs Load	Chadron-Hay Springs Total	Hay Springs Long Pine Empty	Hay Springs Long Pine Load	Hay Springs Long Pine Total
Avg.	9.5312	7.8573	85.36	560.650	753.338	20.3	166.6	186.9	10.4225	2649.421	12.136	13428.125	14242.581	65.834	6.7241	10.2177	3427.94	16000	217.38	14.75	8.75	23.5	17.75	12	29.75

LONG PINE-CHADRON-WEST- BITUMINOUS COAL (CLASS-Q-) EXTRA FREIGHT

1912	Time-Hours Elapsed	Time-Hours Running	Avg. Temp. Atmo.	Tonnage	Mileage	Coal Used-Tons	Coal Used-Pounds. Per Hour.	Coal Used-Pounds. Per Horse Power Hour	Water Used-Gallons.	Water Used-Lbs. Per Hour.	Water Used-Lbs. Per Horse Power Hour	Ton-Miles-Per Pound Coal	Ton-Miles-Per Gallon Water	Average Draw Bar Pull Pounds.	Maximum Draw Bar Pull. Pounds	Work Done Horse Power Per Hour	No. Cars in Train Chadron-Long Pine Empty	Chadron-Long Pine Load	Chadron-Long Pine Total
Avg.	10.0291	8.5510	85.07		192.675	11.75	2760.406	10.355	15756.25	15385.227	57.779	4.2072	6.2939	4422.06	15000	266.76			

CHADRON-LONG PINE-EAST- OIL BURNER (CLASS-Q-) EXTRA FREIGHT

1912	Time-Hours Elapsed	Time-Hours Running	Avg. Temp. Atmo.	Tonnage Chadron Hay Springs	Tonnage Hay Spg's Long Pine	Mileage Chadron Hay Spgs	Mileage Hay Sp'gs Long Pine	Mileage Total	Oil Used-Gallons	Oil Used-Gallons Per Hour	Oil Used-Gallons Per Horse Power Hour	Water Used Gallons.	Water Used-Lbs Per Hour	Water Used-Lbs Per Horse Power Hour	Ton Miles-Per Gallon Oil	Ton Miles-Per Gallon Water	Average Draw Bar Pull. Pounds.	Maximum Draw Bar Pull Pounds	Work Done Horse Power Per Hour	No. Cars In Train Chadron. Hay Springs Empty	Chadron. Hay Springs Load	Chadron. Hay Springs Total	Hay Springs Long Pine Empty	Hay Springs Long Pine Load	Hay Springs Long Pine Total
Avg.	10.43745	8.6625	50.26	511.688	692.953	19.65	171.4	191.05	1655.5	190.454	0.7668	17537.5	16820.810	67.861	79.840	7.4785	4236.62	15750	248.61	21	5	26	4.8	2.8	7.5

LONG PINE-CHADRON-WEST- OIL BURNER (CLASS-Q-) EXTRA FREIGHT

1912	Time-Hours Elapsed	Time-Hours Running	Avg. Temp. Atmo.	Tonnage	Mileage	Oil Used-Gallons.	Oil Used-Gallons Per Hour	Oil Used-Gallons Per Horse Power Hour	Water Used Gallons	Water Used-Lbs. Per Hour	Water Used-Lbs. Per Horse Power Hour	Ton-Miles-Per Gallon Oil.	Ton-Miles-Per Gallon Water	Average Draw Bar Pull. Pounds.	Maximum Draw Bar Pull. Pounds.	Work Done Horse Power Per Hour.	No. Cars in Train Long Pine Chadron Empty	Long Pine Chadron Load	Long Pine Chadron Total
Avg.	10.1917	8.6511	54.05	560.663	191.0	1777.5	205.494	0.7453	18121.875	17485.697	63.234	60.747	5.9538	4690.22	15500	278.05	5.3	14.3	19.5

PER CENT SAVING IN COST OF OIL OVER BITUMINOUS COAL

Direction	In Fuel	Per Horse Power Hour	Per Ton Mile
East	19.83	36.22	14.97
West	23.65	27.35	30.09
Average	21.74	31.78	22.53

Gallons of Oil Required to Equal One Ton Bitum. Coal	
Per Horse Power Hour	Per Ton Mile
134.5	155.5

PER CENT SAVING IN COST OF OIL OVER LIGNITE COAL

Direction	In Fuel	Per Horse Power Hour	Per Ton Mile
East	36.81	32.55	29.50
West	40.38	31.83	35.86
Average	38.59	32.19	32.68

Gallons of Oil Required to Equal One Ton of Lignite Coal	
Per Horse Power Hour	Per Ton Mile
104.39	104.32

PER CENT SAVING IN COST OF BITUMINOUS OVER LIGNITE COAL. AVERAGE EAST & WEST.

In Fuel	Per Horse Power Hour	Per Ton Mile
43.66	1.27	31.06

PASSENGER SERVICE

CHADRON-LONG PINE -EAST- OIL BURNERS (CLASS-Q) PASSENGER TRAIN No6

1912	Time		Average Temp.	Oil used Gallons	Water used Gallons	Average Draw Bar Pull Pounds	Maximum Draw Bar Pull Pounds	Work Done Horse Power Per Hour	Oil Used-Gallons		Water Used-Pounds	
	Elapsed	Running							Per Hour	Per Horse Power Hour	Per Hour	Per Horse Power Hour
Avg.	6.5219	5.8614	42.51	940.5	10128.125	1235.14	10,750	107.99	160.509	1.4937	14387.837	134.118

LONG PINE-CHADRON - WEST- PASSENGER TRAIN No3

1912	Time		Average Temp.	Oil used Gallons	Water used Gallons	Average Draw Bar Pull Pounds	Maximum Draw Bar Pull Pounds	Work Done Horse Power Per Hour	Oil Used-Gallons		Water Used-Pounds	
	Elapsed	Running							Per Hour	Per Horse Power Hour	Per Hour	Per Horse Power Hour
Avg.	6.5719	6.0875	45.08	1459.25	13721.875	2799.69	13,500	235.77	239.883	1.0277	18788.941	80.405

CHADRONE-LONG PINE - EAST- BITUMINOUS BURNERS (CLASS-Q) PASSENGER TRAIN No6

1912	Time		Average Temp.	Coal used Tons	Water used Gallons	Average Draw Bar Pull Pounds	Maximum Draw Bar Pull Pounds	Work Done Horse Power Per Hour	Coal Used- Pounds		Water Used- Pounds	
	Elapsed	Running							Per Hour	Per Horse Power Hour	Per Hour	Per Horse Power Hour
Avg.	6.4355	5.7865	56.96	9.513	9087.5	1216.08	11,625	108.09	3291.0385	30.442	13084.622	121.598

LONG PINE - CHADRON -WEST- PASSENGER TRAIN No3

1912	Time		Average Temp.	Coal used Tons	Water used Gallons	Average Draw Bar Pull Pounds	Maximum Draw Bar Pull Pounds	Work Done Horse Power Per Hour	Coal Used- Pounds		Water Used- Pounds	
	Elapsed	Running							Per Hour	Per Horse Power Hour	Per Hour	Per Horse Power Hour
Avg.	6.6302	6.1386	54.73	14.838	12984.38	2707.01	15,000	227.21	4837.4870	21.346	17623.102	77.907

Per Cent Saving in Cost of Oil over Bituminous Coal.

Direction	In Fuel	Per Horse Power Hour	Per Ton Mile
East	50.10	50.47	46.58
West	50.36	51.40	51.44
Average	50.23	50.94	49.01

Gallons of Oil Required to Equal One Ton Bituminous Coal	
Per Horse Power Hour	Per Ton Mile
97.38	100.12

Comparative Locomotive Tests of Oil and Bituminous Coal Burners in Passenger Service, C. & N. W. Railway.

FREIGHT TEST

Per Cent Saving in Cost Oil over Bitum. Coal		Gals. Oil Required to Equal One Ton Bitum. Coal	Per Cent Saving in Cost Oil over Lignite Coal		Gals. Oil Required to Equal One Ton Lignite Coal	Per Cent Saving in Cost Bitum. over Lignite Coal	
In Fuel	Per HP Hour	Per HP Hour	In Fuel	Per HP Hour	Per HP Hour	In Fuel	Per HP Hour
21.74	31.78	134.5	38.59	32.19	104.39	43.66	1.27

PASSENGER TEST

Per Cent Saving in Cost Oil over Bitum. Coal		Gals. Oil Required to Equal One Ton Bitum. Coal
In Fuel	Per HP Hour	Per HP Hour
50.23	50.94	97.38

Per Cent Saving in Cost Hauling Oil over Coal		
Freight Test		Passenger Test
Oil over Bituminous Coal	Oil over Lignite Coal	Oil over Bituminous Coal
74.83	71.19	81.80

Per Cent Saving in Cost of Hauling Empty Oil Cars over Empty Coal Cars		
Freight Test		Passenger Test
Oil Cars over Bituminous Coal Cars	Oil Cars over Lignite Coal Cars	Oil Cars over Bituminous Coal Cars
68.09	63.60	77.00

Tons Coal Corresponding to 10,000 Gallons Oil		
Freight Test		Passenger Test
Bituminous	Lignite	Bituminous
74.35	95.79	102.69

Summary of Entire Set of Locomotive Fuel Tests, C. & N. W. Railway.

runs on two separate engines—four runs in all. In the west-bound test on bituminous coal, the tonnage is not given, as it varied from 439 to 561; the average being about 534. All other tonnages ran very evenly. In general the figures from which averages were reached did not show a wide degree of variation. As the tests covered a period of two or more months, it will be noted that atmospheric temperatures ranged between the limits of 40 degrees and 90 degrees.

The average number of gallons of oil used per horsepower-hour divided by the number of tons of bituminous coal used per horsepower-hour gave the gallons of oil required to equal one ton of bituminous coal per horsepower-hour. This was found to be 134.5 gallons in freight service and 97.38 gallons in passenger service. In a similar manner, the gallons of oil required to equal one ton of bituminous coal per ton-mile was found to be 155.5 gallons in freight service and 100.12 gallons in passenger service.

In arriving at the percentage of saving of one fuel over another, the following items were taken into consideration in determining the total cost of the fuel; cost at point of delivery, cost of hauling car and fuel to storage point and cost of hauling empty car back to delivery point. The table of final results gives also the per cent saving in cost of hauling oil over bituminous coal and also the per cent saving in cost of hauling empty oil cars over empty coal cars. The percentage of saving here is very high, ranging around 75 per cent, although to be expected, owing to the location of the sources of the various fuels, as before mentioned. This table also gives the tons of bituminous coal and lignite corresponding to 10,000 gallons of oil, as determined from the tests.

In freight service the oil shows a saving in cost over bituminous coal of 31.78 per cent per horsepower-hour and 22.53 per cent per ton-mile. The saving in cost of fuel is 21.74 per cent. Now this cost of fuel, wherever given in the test data, refers only to the cost of fuel used during the run and has nothing whatever to do with the work performed. That is, it is simply the cost of the fuel on the tender, irrespective of tonnage or power developed.

In the same service the oil shows a saving per horsepower-hour over lignite of 32.19 per cent, while the percentage saving per horsepower-hour of bituminous coal over lignite is very small, being but 1.27 per cent. It will be noted that the saving in fuel of bituminous coal over lignite, is the highest, being 43.66 per cent.

In passenger service, the percentage saving in cost of oil over bituminous coal, as regards the fuel used, is 50.23 per cent; the saving per horsepower-hour is 50.94 per cent and per ton-mile is 49.01 per cent. These results show substantial increase in saving in passenger service over freight service.

The results of these tests confirmed the preliminary tests previously made and proved that the North-Western, due to its advantageous location with respect to the Wyoming oil field, can use oil very advantageously on its Lines West. At present it has about 53 oil burners in service and 73 more are being fitted up. There are still about 21 lignite burners in freight service, and after the 73 oil burners have been put in service nothing but oil and lignite will be used on the western lines. We are indebted to the various officials of the mechanical department of the North-Western for the above information and data.

W. J. HARAHAN has resigned as president of the New York Railroad Club owing to his election as president of the Seaboard Air Line, which necessitated his removal from New York. Eugene Chamberlin, of the New York Central Lines, has been elected by the executive committee to succeed him. These changes have resulted in George Wildin, of the New York, New Haven & Hartford, becoming first vice-president; C. W. Huntington, of the Central of New Jersey, second vice-president, and F. C. Syze, of the Baltimore & Ohio, third vice-president.

INSTRUCTION CAR, ILLINOIS CENTRAL R. R.

One of the most remarkable developments of the past few years has been that of the moving picture. It has reached quite an advanced state in the field of entertainment, but its possibilities in the field of education are just beginning to be realized. However, some of the leading moving picture companies are now advertising their industrial departments, making a specialty of taking pictures of manufacturing processes for educational work.

The Educational Bureau, at Omaha, which covers the Union Pacific, Illinois Central and Central of Georgia railways, early saw the benefits which might be derived from moving pictures, and at present is making extended use of them. A new instruction car has been fitted up on the Illinois Central with moving picture facilities, and is being sent over the road to demonstrate the proper and improper methods of firing locomotives. The car is simply an old passenger coach which has had a few seats taken out at one end and the moving picture machine installed in their place, a screen being placed at the other end of the car. The total cost for the fixing up of the coach alone is not over $25. The car is equipped with one of the late model projection machines and the installation is made as near fireproof as possible. The electric current is obtained by a connection to the lighting circuit of the town in which the car happens to be located.

Accompanying the Illinois Central car are O. W. Lindrew and J. W. Dodge, the former being an experienced road foreman of engines, who gives the lecture and handles the the instruction work. Mr. Dodge makes a personal investigation of fuel conditions at each terminal and reports to the general manager any conditions which tend towards the uneconomical use of fuel.

The Educational Bureau has its own moving picture machine and makes all its own pictures. These pictures are taken on engines and in yards showing actual conditions connected with good and poor firing. They show views of the fireman at work, engine popping, coal being spilled off the tender, results of firing as seen from the observation platform and a dummy cross-section showing proper and improper methods of throwing in coal. Supplementary to this, there is also a booklet on "Proper Method of Firing Locomotives." The men have taken a great deal of interest in the demonstrations and it is expected that the field opened up by this work will be very fertile in effecting greater fuel economies.

During December 7,218 cars were repaired at the Saginaw shops of the Pere Marquette, 5,701 of which were foreign. A very good percentage of foreign cars.

An Irishman, just landed, got work on the New York Central at Tarrytown. His first day on the job he waved the red danger signal before the Empire State Express. The brakes screeched down, the train stopped, and the crew ran up. "What's the matter? Why did you stop this train?" the conductor demanded.

"Well——" began the flagman.

"Don't you know its a state prison offense to stop a train without cause?" the conductor explained. "Why, we're twenty minutes late now."

"That's just it," was the answer. "Where have yez been the last twinty minutes?"—*Newark Star.*

MALLET COMPOUNDS FOR THE DENVER & RIO GRANDE.

The Denver & Rio Grande Railroad has lately secured from the American Locomotive Company sixteen Mallet compound locomotives of the 2-8-8-2 type. These big locomotives were designed to meet specific conditions presented in balancing train tonnage over a very heavy grade on the Salt Lake division.

With a specified maximum axle load of 50,000 pounds, they are thought to be the most powerful locomotives that could be built. They represent the very latest information as to proportion and employ the best economy factors. After giving careful study to the physical and operating conditions of the road, the railway officials co-operated with the builders in the production of this design.

One of these Mallet locomotives will take the place of two consolidations now used as helpers, and the consolidations will then become available for road service. Not only will the number of locomotives per train be reduced, but a greater tractive effort per train will be obtained, which can be used to meet increased tonnage or adverse conditions.

In accordance with the profile, from Springfield to Thistle, a distance of fifteen miles, the maximum resistance is due to a 1.0 per cent grade in combination with 7½ degree curves. From Thistle to Tucker, a distance of 17 miles, the maximum resistance is a 2.3 per cent grade in combination with 8 degree curves. From Tucker to Summit, a distance of 7.9 miles, the maximum resistance is due to a 3.97 per cent grade in combination with 11 degree curves. This is the crucial part of the division.

Hitherto the freight traffic on this division has been handled by consolidation locomotives having a total weight of 221,000 pounds and a tractive effort of 42,000 pounds.

These new Mallets have a total weight of 458,000 pounds, 394,000 being on drivers. The high pressure cylinders are 26 inches in diameter by 32 inches in stroke, and the low pressure cylinders are 40 inches in diameter by the same stroke. With the boiler pressure of 200 pounds and driving wheels 57 inches in diameter, the theoretical maximum tractive power, working compound, is 93,400 pounds.

With the American Locomotive Company's system of compounding, the normal maximum tractive power can be increased 20 per cent by changing the engine into working simple. The maximum tractive power of these engines, working simple, is thus 112,000 pounds.

The boiler is of the radial stay type with conical connection sheet. At the first course, the barrel measures 85¾ inches in diameter outside, while the outside diameter of the largest course is 100 inches.

The boiler is fitted with 255 tubes 2¼ inches in diameter and 36 flues 5½ inches in diameter, all 24 feet long.

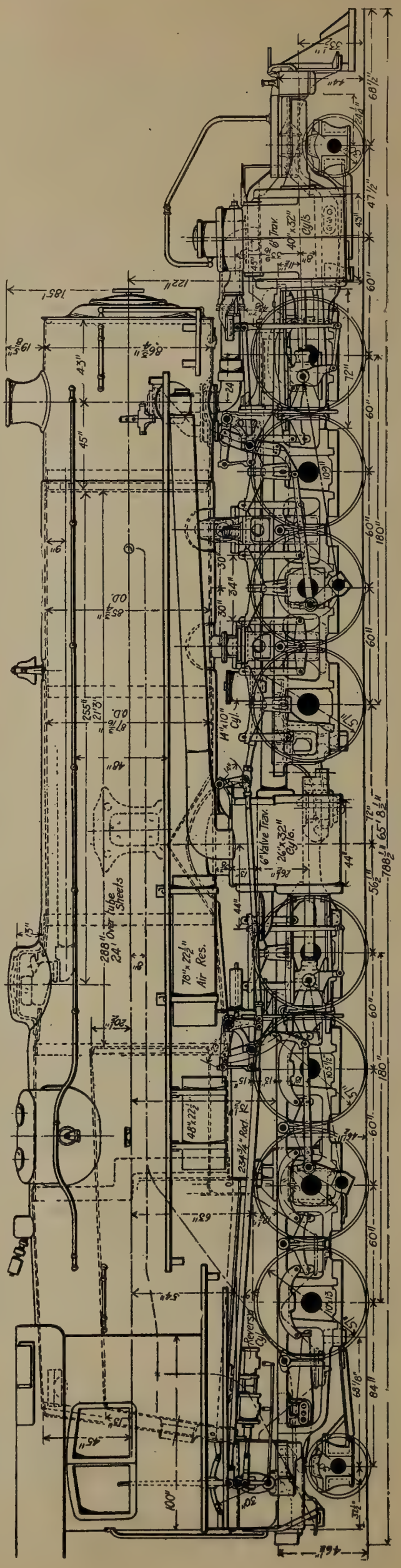
The firebox is 120⅛ inches long and 96¼ inches wide, and provides a grate area of 80.3 square feet. A combustion chamber 76 inches long is also included.

High temperature superheat is obtained by the use of a 36 unit, Schmidt type, double loop, top header superheater.

Details of this design follow in general the standards of the builder. Reversing is effected by means of the builder's well known hydro-pneumatic reversing gear. Air operated fire-door and ash pan are also applied.

The following comparison of the new Mallets with the consolidation locomotives is interesting:

	Mallets.	Consolidations.
Type	2-8-8-2	2-8-0
Weight on drivers	394,000	196,300
Weight on truck	31,500	.....
Weight on trailer	32,500	.....
Weight total, running order	458,000	221,000
Wheel base, rigid	15 ft. 0 in. and 15 ft. 0 in.	15 ft. 8 in.
Wheel base, total engine	56 ft. 8 in.	24 ft. 11 in.
Tractive power	93,400	42,000
Valve gear	Walschaert	Walschaert
Cylinders, diameter and stroke	26 and 40x32	23x28.
Driving wheels, dia. outside	57 in.	57 in.
Trailing wheels, dia. outside	30½ in.	.....
Truck wheels, dia. outside	30½ in.	.....



Mallet for the Denver & Rio Grande R. R.

Boiler type	Con. Conn.	Ex. wagon top
Boiler, outside dia. of 1st ring	85¾ in.	76⅝ in.
Boiler, outside dia. of largest course	100 in.	84 in.
Height over crown, front	28 5/16 in.	28½ in.
Working pressure	200 lbs.	190 lbs.
Firebox length	120⅛ in.	108 1/16 in.
Firebox width	96¼ in.	65¼ in.
Tubes, number and diameter	255-2¼ in., 36-5½ in.	364-2 in.
Tubes, length	24 ft. 0 in.	15 ft. 0 in.
Combustion chamber length	76 in.	.....
Heating surface, tubes	3,590.9 sq. ft.	2,841 sq. ft.
Heating surface, flues	1,239.2 sq. ft.	.....
Heating surface, firebox	339.6 sq. ft.	179 sq. ft.
Heating surface, total	5,169.7 sq. ft.	3,020 sq. ft.
Superheating surface	998.0 sq. ft.	.....
Grate surface	80.3 sq. ft.	49 sq. ft.
Tender capacity, gals.	9,000	8,000
Tender capacity, tons	15	12
Length over all, engine and tender	95 ft. 5⅞ in.	70 ft. 4 in.
Extreme width	11 ft. 1½ in.	10 ft. 4 in.
Extreme height	15 ft. 5 in.	15 ft. 2¼ in.

SAFETY FIRST.

What will probably be the greatest railway safety movement ever inaugurated is that which the Pennsylvania, co-operating with other lines in the eastern territory, is starting.

As one illustration of the interest taken by railway employes in the safety movement, it has been pointed out that over thirteen hundred people attended a Pennsylvania safety rally in Trenton, New Jersey, early in December. Lectures illustrated with photographs, lantern slides and tables of statistics were given by members of the railroad's safety committee.

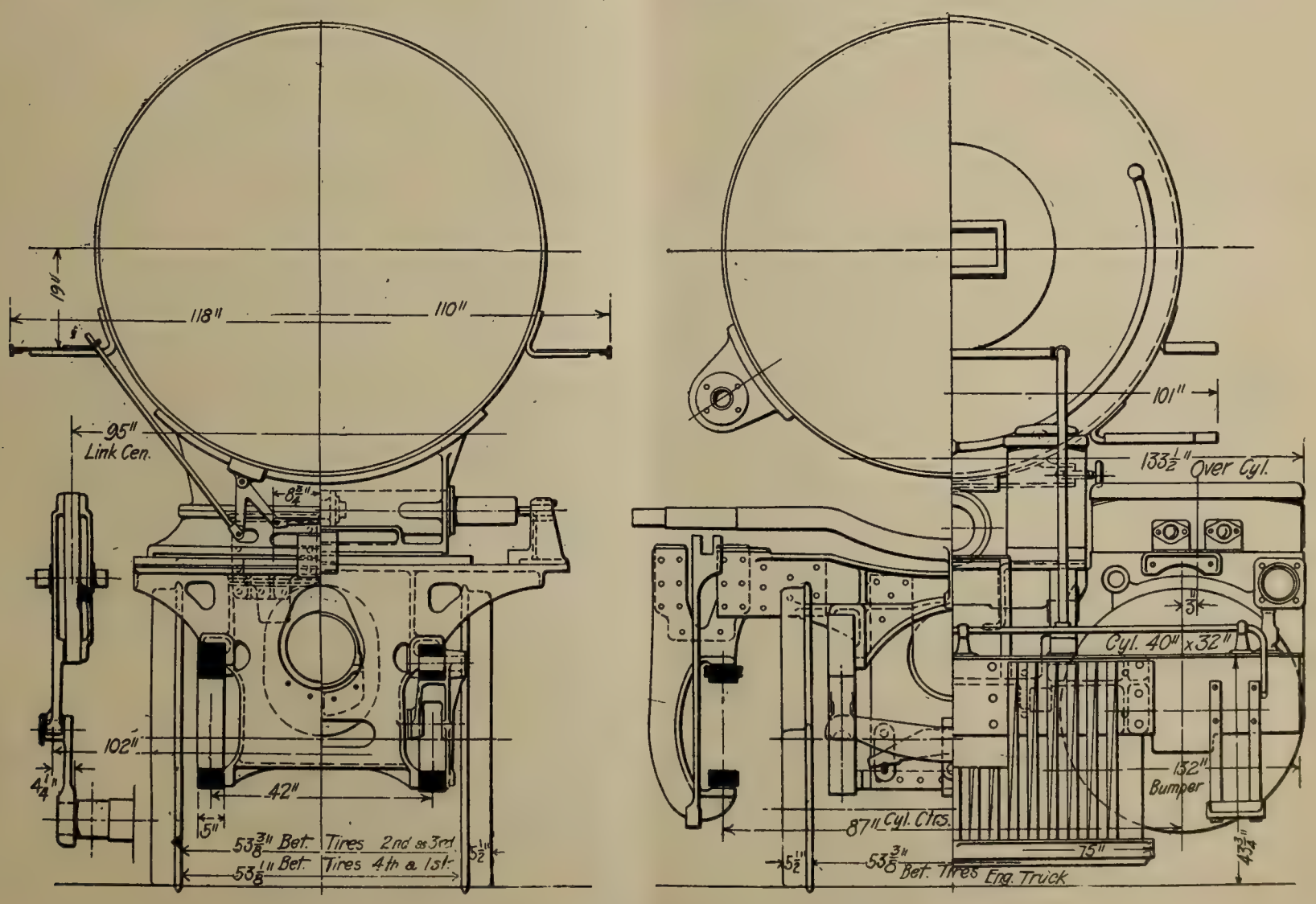
With the view that a campaign for safety can only be made effective if the general public as well as railroad employes become interested, the Pennsylvania is organizing open "Safety First" meetings to be held in Altoona, Wilmington, Williamsport, Pittsburgh, Washington and other division points and has invited all the railroads running into those cities to cooperate.

Definite arrangements are being made for the meetings in Altoona and Harrisburg, and it is expected that in addition to the practical talks to be given by employes of the different railroads, and by R. C. Richards, chairman of the General Safety Committee of the Chicago & North Western, there will be short addresses by some of the railway executives.

LOCK GATE INSPECTION.

Six million rivets are required in the lock gates of the Panama Canal and every one of them is carefully inspected before the contractor is paid for driving them. The inspection and testing of the gates are necessary to ensure a thoroughly good job. To properly protect the Government, 5 per cent of the total price is withheld until the gates prove themselves satisfactory by actual use.

Inspection of materials begins at the steel mills and of



Sections of Mallet for Denver & Rio Grande R. R.

workmanship, at the shops of the contractor near Pittsburgh. Inspection on the Isthmus is confined to erection methods and workmanship.

The gate leaves are shells of structural steel covered with a sheathing of steel riveted to the girder framework. They are 65 feet long, 7 feet thick and from 47 to 82 feet high. Each leaf is divided horizontally into two separate compartments. The lower compartment is watertight, for the purpose of making the leaf so buoyant that it will practically float in the water and thus largely relieve the stress upon the bearings by which it is hinged to the wall. This watertight compartment is subdivided vertically in three sections, each independently watertight so that if the shell should be broken in any way or begin to leak, only one section would probably be affected. An air shaft 26 inches in diameter runs from the bottom compartment up to the top of the gate, and this also is watertight where it passes through the upper half of the leaf.

After placing the steel plates upon the frame, the rivets are driven with care, and the edges of the plates are caulked, and inspectors follow closely each portion of the work. Within the steel shell, made intensely warm from direct exposure to the sun, inspectors examine and test each rivet by the light of a candle, and marking those that are defective. Sometimes the head has been driven into the steel frame, again it will not center on the bolt, or it may be loose or broken. All imperfect rivets are rejected and cut out, and replaced by new rivets.

Watertightness is determined by filling the gate leaves with water. Inasmuch as the leaves are built to withstand pressure from without only, this is a severe test. One of the leaves at Gatun that is 77 feet high and weighs about 700 tons has been filled, through the air shaft mentioned above, to the full 77-foot height with five hundred tons of water. This gives a pressure of 32 pounds to the square inch at the bottom. So well has the work been done that only a few rivets show a tendency to "weep," and leaks develop in only very few of the joints. The results obtained have been surprising to the chief inspector, who has had many years experience in ship building, because the hydrostatic test on ship hulls usually reveals many more leaks at the rivet holes than have been found in the lock gates.

The lock gate inspection force on the Isthmus consists of about twenty men working in three sections under foremen experienced in shipyard work.—*Canal Record.*

MEETING OF THE FUEL ASSOCIATION.

The next annual meeting of The International Railway Fuel Association will be held at the Hotel Sherman, Chicago, from May 21 to 24, 1913, inclusive. The following subjects will be taken up:

"Standard Form of Contract Covering the Purchase of Railway Fuel."

"Location, Construction, Development and Operation of a Bituminous Coal Mine."

"Sub-Bituminous and Lignite Coal as a Locomotive Fuel."

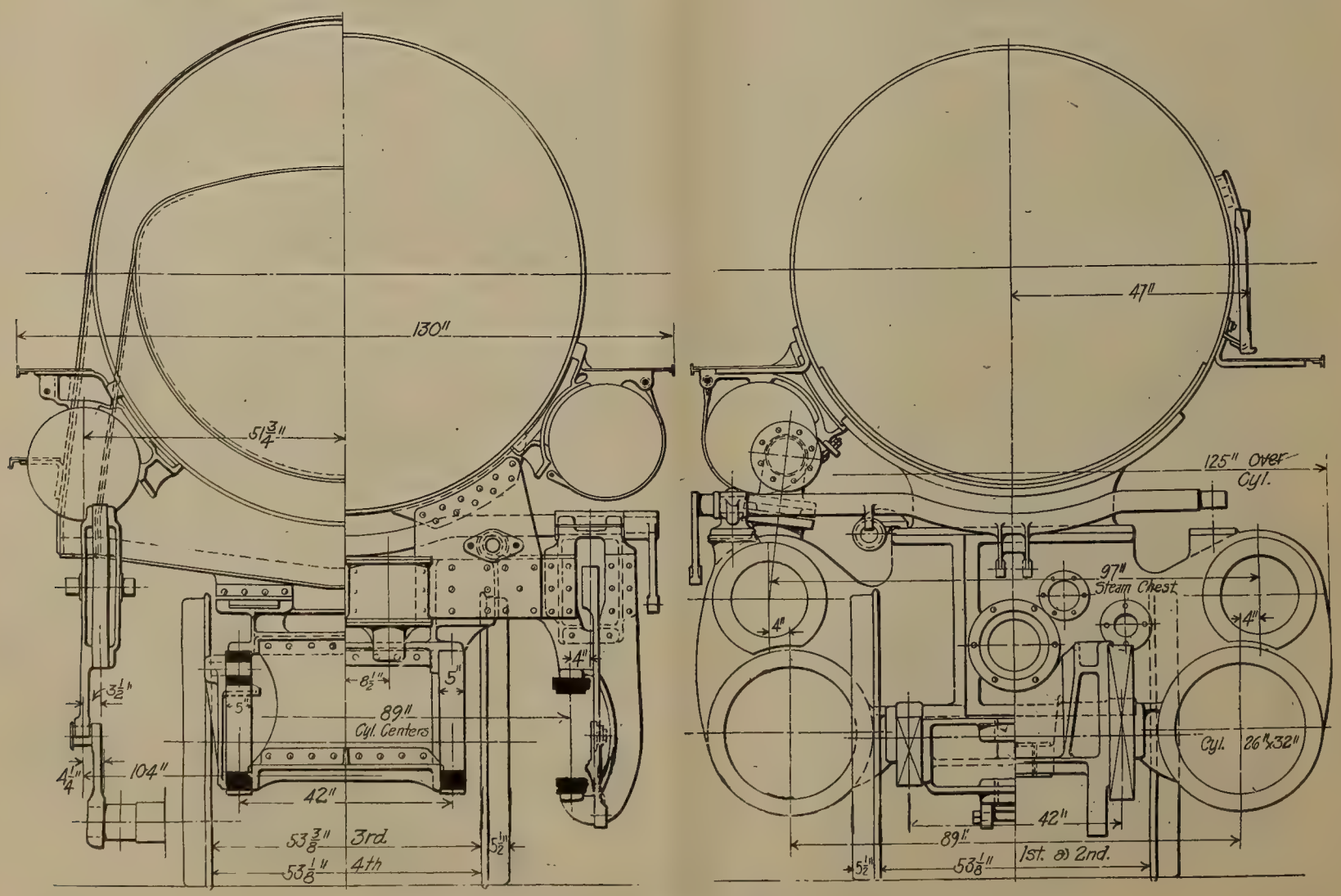
"The Internal Combustion Engine as Applied to Railway Service."

"Modern Locomotive Coaling Station—Its Description, Construction, Operation and Maintenance."

"Development of the Locomotive Brick Arch and Its Results in Fuel Economy."

It will be remembered that H. T. Bentley, assistant superintendent of motive power of the Chicago & North-Western, is president of this association this year, which insures a good convention.

THE CALGARY SHOPS of the Canadian Pacific in Alberta, which are nearing completion, are giving a great impetus to the growth of Calgary and the surrounding country. A large number of industrial firms will locate branch offices there and big manufacturing firms which have decided to locate there will employ about 10,000 men. The bank transactions of Calgary, as shown through the clearings in 1911, totaled $219,245,878, an increase of 38 per cent over 1910.



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Comparative Tests of Jacobs-Shupert and Radial Stay Boilers*

INTRODUCTION.

The Jacobs-Shupert United States Firebox Company, in undertaking the manufacture and sale of a new type of steam boiler, early determined to conduct an elaborate series of tests as a preliminary step in the development of its business. There had already been numerous tests designed to disclose the behavior of various details entering into the construction of the boiler, and there were already 169 locomotives having Jacobs-Shupert boilers in successful operation. In addition to these significant facts, the company desired for its own information and for the information of boiler users in every field of service, to make of record a correct and comprehensive statement of the merits of the new type of boiler. A tentative program of tests was drawn up and its execution was intrusted to W. F. M. Goss, who, as expert in charge, was given a free hand in the working out of the details. It is the purpose of this report to present a full statement of the work done and of the results obtained.

In co-operation with Charles Ducas, the able technical manager of the Jacobs-Shupert United States Firebox Co., the elaborate series of tests which has now been concluded, was planned. The tests have involved the construction of two modern locomotive boilers, differing from each other only in the fact that one was fitted with a Jacobs-Shupert firebox and the other with a radial-stay firebox. Both boilers were built to the general dimensions of a certain standard of the Atchison, Topeka & Santa Fe Ry. The firebox employed in the construction of the Jacobs-Shupert boiler was not especially made for the test, but by permission of the Santa Fe was taken at random from a number of similar fireboxes under construction for that company. No radial-stay firebox for a boiler of the dimensions selected was available, and as a consequence, one was especially constructed, its overall dimensions being made to agree accurately with those of the Jacobs-Shupert firebox. Each boiler, as first constructed, was partitioned off into two compartments by an extension of the back tube-sheet in all directions to the outside shell of the boiler. The tests made when the boilers were thus equipped permitted a separate determination of the heat transmitted by the firebox heating surface and by the tube heating surface. The performance of the boilers thus equipped was determined when oil and coal respectively were used as fuel. This work having been completed, the partitions were removed and the boilers subjected to such reconstruction as was necessary to make them normal to conditions of service. Tests were then made to establish the performance of the two normal boilers. This accomplished, each boiler was subjected to a test of strength under low-water conditions. While one important purpose of the report is to discuss and summarize the results obtained, a most interesting and promising field of study is supplied by the unembellished numerical data derived from the tests.

Summary of the Complete Series of Tests.

The radial-stay boiler is recognized as the most important detail of the modern high-power locomotive. Many embellishments in its construction have from time to time been introduced, and present-day designs represent a highly developed practice. But forces are always present within the structure of the radial-stay boiler which make its maintenance difficult and which ultimately bring about its ruin. Like all its predecessors, the radial-stay boiler is weak under low-water conditions, and failures, sometimes disastrous, are not uncommon. No one who considers the progress of the past can assume for a moment that our present-day practice is final. The radial-stay boiler has had its predecessors and they have disappeared, and no one can doubt that the radial-stay boiler itself is but an embryo predecessor of a type which must soon be revealed.

The Jacobs-Shupert boiler seeks to overcome some of the defects of the radial-stay type. Its firebox construction is more than a modification of pre-existing forms; it is new in its contour, in the means employed for its support, and in the fact that it is made up of a considerable number of comparatively small plates. The contour of the Jacobs-Shupert firebox is not dissimilar to that of the corrugated furnaces so long and so generally used in marine service. It has no radial stays and there are no stay-bolts except in the tube sheet and door sheet. There are no rivets or stay-heads on the fire side of the crown sheet or side sheets. The rivets joining the several sections making up the firebox structure are not inside of the firebox. They can not be seen from the firebox, and they can not be affected by the direct action of the heat from the firebox. They are above the crown in the water space of the boiler at a distance sufficiently far from the heating surface of the firebox to be undisturbed by any condition that may arise within the firebox. These features place the design of the Jacobs-Shupert boiler upon a plane which, from a purely mechanical point of view, is essentially higher than that which is occupied by the normal radial-stay boiler. The fact also that in the manufacture of these boilers, the principle of interchangeability is employed, establishes a high standard of workmanship. Interchangeability in construction operates to improve quality and to reduce costs. In the manufacture of the Jacobs-Shupert firebox, machinery is used instead of men. Each operation is simple and yet the result is precise. There is no drifting of holes and no local heating of plates which have been set in place in the boiler. The result of the new process is a boiler accurately made, substantially put together, and comparatively free from initial strains. The design and the methods of manufacture combined permit repair parts to be carried, and provide an inexpensive procedure in maintenance.

The Jacobs-Shupert boiler in service was made the subject of an inspection at several division points, and on the road along the line of the Santa Fe, where at the time of the inspection (November, 1911), 169 locomotives were in service. As a result of five days' inspection, conclusions were reached as follows:

1. The construction of the Jacobs-Shupert firebox admits of easy and thorough inspection.
2. The Jacobs-Shupert firebox gives no trouble by leaking at the mud-ring. Not a single case of a leaky mud-ring could be found.
3. The fireboxes give no trouble by leaking between sections.
4. No indication could be found of grooving or cracking

*These tests were described in the *Railway Master Mechanic* issues for June and July, 1912. This article is taken from the report of Dean W. F. M. Goss to A. F. Huston. Extracts from the report itself will be published in later issues of the *Railway Master Mechanic*.

at the fillet or in any other part of the sections making up the firebox.

5. The fireboxes examined, while very large, appear to resist perfectly the pressure imposed, which in all cases was above 200 pounds.

6. The firebox structure of a Jacobs-Shupert boiler after a year of service in a district of alkali water, appeared as though new, while that of a radial-stay boiler in the same service for the same or a lesser length of time presented unmistakable evidences of degeneration.

7. Evidence was not lacking to prove that minor defects, such as those which may arise in a Jacobs-Shupert boiler from accumulation of scale or because of low water, are easily repaired.

Some months after this inspection, it was reported that defects had appeared in the outside wrapper sheets of some of the older boilers. The cause was easily seen to be in a defective arrangement of some of the longitudinal stays, and the remedy was simple. The occasion for the occurrence of such defects is avoided in more recent designs.

A program of test designed to disclose the performance of the Jacobs-Shupert boiler in comparison with that of a radial-stay boiler was outlined as follows:

The boilers to be tested were to be designed for locomotive service and to be identical in their general dimensions. They were to differ from each other only in the construction of the firebox and in the means employed for supporting it. One boiler was to be equipped with a Jacobs-Shupert firebox and the other with a radial-stay firebox conforming to the best present-day practice.

A laboratory was to be provided in which the two boilers could be erected and equipped with all apparatus necessary for testing. The tests specified were to be grouped into three series designated as Series A, B and C, respectively.

Series A was planned to disclose the relative amount of heat absorbed by the fireboxes and by the tubes of the two boilers under similar conditions of operation. To facilitate these tests, it was proposed to have the boilers constructed with a partition separating the water space into two compartments, one of which was to include the firebox surface and the other the tube surface. In carrying out the tests, these compartments were to be separately fed with weighed water. Not less than three tests, one at low power, one at medium power, and one at high power, were to be made upon each boiler. It was believed that the results would serve to establish the relative value of a unit area of firebox heating surface as compared with that of a unit area of tube-heating surface—facts which American engineers have long desired to know—and that they would disclose the difference, if any, in the heat-absorbing capacity of the two fireboxes tested.

Series B was to be made up of tests of normal boilers. The boilers which had served in the tests of Series A were to undergo such reconstruction as might be found necessary to the removal of the partitions. This accomplished, there would be available for the further work a normal Jacobs-Shupert boiler and a normal radial-stay boiler. Each boiler was then to be subjected to a series of evaporative tests for the purpose of establishing its evaporative efficiency and capacity under different rates of power. In addition to data usually secured in boiler testing, it was proposed to make of record such information as might be possible concerning the circulation of water within the two boilers. The purpose of this series was to secure an accurate measure of the evaporative performance of the Jacobs-Shupert boiler and of a normal radial-stay boiler.

Series C was planned to disclose the relative strength of the two boilers under low-water conditions. In preparation for the tests of this series the boilers were to be removed from the testing laboratory and set up with everything necessary to their operation in a location where their explosion would result in no harm to surrounding property. Adequate provisions were to be made for the safety of observers. The boilers were to be operated, the supply of feed-water was to be cut off or so controlled that the firebox would be uncovered, and the low-water conditions were to be continued until failure occurred.

The general dimensions of the boilers tested were as follows:

	Jacobs-Shupert	Radial-Stay
Type of boiler	Ex. wagon top	Ex. wagon top
Diameter of shell	70 ins.	70 ins.
Number of 2¼-in. tubes	290	290
Length of tubes	18 ft. 2 ins.	18 ft. 2 ins.
Length of firebox	9 ft. 1⅝ ins.	9 ft. 1 11-16 ins.
Width of firebox	6 ft. 4⅜ ins.	6 ft. 4¼ ins.
Total heating surface	3008.4	2989.3

The percentage of the total heat absorbed by the boiler, which is taken up by the firebox, varies with the rate of power at which the boiler is worked. It is affected also by the character of the fuel used.

When oil fuel was fired at the rate of 2,200 lbs. an hour:

(a) The Jacobs-Shupert boiler evaporated 40,000 lbs. of water per hour. Of this amount, 16,000 lbs. were evaporated by the firebox and 24,000 lbs. by the tubes.

(b) The whole boiler developed 1,200 h. p., of which amount nearly 500 h. p. was developed by the firebox.

(c) The average rate of evaporation per foot of heating-surface per hour for the whole boiler was 9.78 pounds.

(d) The average rate of evaporation per foot of heating-surface per hour for the firebox was 49.59 pounds, and for the tubes 6.47 pounds.

(e) The ratio of heat absorbed per foot of heating-surface by the firebox to that absorbed per foot of tube heating-surface was as 7.6 to 1.

When oil is used as fuel, the percentage of the total heat absorbed that is taken up by the firebox can be found by dividing the pounds of oil fired per hour by 100 and subtracting the quotient from 62. Strictly speaking, the application of this statement should be limited to those rates of firing which were covered by the experiments; that is, to rates between the limits of 700 pounds and 2,200 pounds of oil per hour.

When a long-flamed bituminous (Dundon) coal was fired at the rate of 4,340 pounds per hour:

(a) The Jacobs-Shupert boiler evaporated 35,405 pounds of water per hour, of which amount 11,982 pounds were evaporated by the firebox and 23,423 pounds by the tubes.

(b) The whole boiler developed 1,026 horsepower, of which amount 304 horsepower were developed by the firebox.

(c) The average rate of evaporation per foot of heating-surface per hour for the whole boiler was 11.77 pounds.

(d) The average rate of evaporation per foot of firebox heating-surface was 51.92, and for the tube heating-surface 8.43.

(e) The ratio of heat absorbed per foot of firebox heating surface to that absorbed per foot of tube heating-surface was as 6.15 to 1.

When long-flamed bituminous coal is used as fuel, the percentage of the total heat absorbed that is taken up by the firebox can be found by dividing the pounds of coal fired per hour by 190 and subtracting the quotient from 56. Strictly speaking, the application of this statement should be limited to those rates of firing which were embraced by the experiments; that is, to rates ranging from 1,400 pounds to 4,500 pounds of coal per hour.

Different fuels produce different results in the distribution of heat. For example, assuming the Jacobs-Shupert boiler to be evaporating 20,000 pounds of water per hour, the per-

centage of the whole quantity of heat absorbed, which is taken up by the firebox, is as follows:

	Per cent.
(a) When oil is used as fuel	42
(b) When long-flame bituminous coal is used as fuel	42
(c) When short-flame bituminous coal is used as fuel	35

Results of evaporative tests of a normal Jacobs-Shupert boiler and a normal radial-stay boiler disclose the evaporative efficiency of the Jacobs-Shupert boiler, unaided by the presence of a brick arch is to be seen in the fact that when fired with 1,315 pounds of Dundon coal per hour it:

(a) Evaporated 15,293 pounds of water per hour.

(b) Evaporated 5.08 pounds of water per square foot of heating-surface per hour.

(c) Evaporated 11.01 pounds of water per pound of coal.

(d) Developed 443 horsepower.

(e) Developed an overall efficiency of 71.86 per cent.

(f) Developed an efficiency, excluding the grate, of 79.75 per cent.

The various effects resulting from operation at higher rates of power may be set forth as follows:

Pounds of coal fired per hour	1,389	3,419	5,930	6,314
Thermal units for each pound of coal:				
(a) Absorbed by water in boiler	10,687	9,327	7,532	7,388
(b) Lost by moisture in coal	42	34	37	33
(c) Lost by moisture in air	49	53	114	54
(d) Lost by hydrogen in coal	486	497	500	514
(e) Lost by smoke-box gases	1,979	2,731	3,992	4,675
(f) Lost by incomplete combustion	78			
(g) Lost by cinders passing up stack	153	851	1,078	1,012
(h) Lost by combustion in ash	1,187	679	291	185
(i) Lost by radiation and unaccounted for	205	547	881	783
Total B.T.U. per pound of coal	14,872	14,719	14,425	14,654

The evaporative efficiencies of the Jacobs-Shupert boiler and of the radial-stay boiler were found to be practically identical.

In the matter of capacity the data show the Jacobs-Shupert boiler to possess some advantages over the radial-stay boiler. The Jacobs-Shupert boiler was forced without the least sign of distress to an unprecedented rate of power. It was fired at the rate of 6,553 pounds of coal per hour, resulting in:

A rate of combustion equaling 119.38 pounds of coal per foot of grate per hour.

An evaporation of 57,564 pounds of water per hour, or the equivalent of 19.13 pounds of water per foot of heating-surface per hour.

The development of 1,669 boiler horsepower, or the equivalent of one boiler horsepower for each 1.8 foot of heating-surface.

An evaporation per pound of coal, notwithstanding the high rate of power developed, of 8.78 pounds of water.

The maintenance of an overall boiler efficiency of 65.34 per cent, and of the boiler, exclusive of the grate, of 67 per cent.

The published records of boiler performance disclose no results of equal significance.

The brick arch as a factor in boiler performance is always beneficial. Its effect depends upon the characteristics of the fuel. When a short-flamed bituminous (Scalp-Level) coal was used, the addition of an arch to either boiler tested, increased the amount of water evaporated per pound of coal 0.6 of a pound; that is, assuming either boiler to be fired with 6,500 pounds of Scalp-Level coal per hour, they will evaporate 7.35 pounds of water per pound of coal without the arch, and 7.95 pounds with the arch, a gain resulting from the introduction of the arch of 8 per cent. The substitution of a long-flamed bituminous (Dundon) coal will, under similar conditions, result in the evaporation of 7.7 pounds of water per pound of coal without the arch, and 8.7 pounds with the arch, a gain resulting from the introduction of the arch of 12 per cent.

Some facts of interest with reference to the circulation of water within a locomotive boiler have been developed. The motion of the water within a locomotive boiler in response to the energy transmitted to it in the form of heat is known to have an important bearing on the upkeep and life of the boiler, and there has been much speculation concerning the direction and strength of the circulating currents. It has been urged, for example, that the presence of the stay-sheets which enter into the construction of the Jacobs-Shupert boiler retard the fore-and-aft movement of water, and that they are, therefore, objectionable. As the stay-sheets are provided with widely distributed openings of large area, such criticisms necessarily assume fore-and-aft currents which are tremendously vigorous. The presence of such vigorous currents has been questioned. An experimental inquiry conducted by Mr. George Fowler sustains the very rational contention that only enough water passes back from the barrel of the boiler to the water-legs of the firebox to make good that which the firebox evaporates. Since the firebox evaporates from 30 to 50 per cent of the water handled by the boiler, a similar percentage of the total feed must, in the case of the Jacobs-Shupert boiler, find its way through the ports in the forward stay-sheet. Some of this water is evaporated before the second stay-sheet is reached. With the passage of each section, the backward flow diminishes until at the last stay-sheet only enough passes to supply that which the last section evaporates.

As the stay-sheets have an aggregate port-area below the water-line of 1½ square feet and as only 30 to 50 per cent of the total water delivered by the injectors must pass by them, it is inconceivable that their presence can affect the circulation unfavorably.

The strongest currents which are set up in a locomotive boiler are those which sweep over the heating-surface in a direction which in its general tendency is vertical. These are the most important of the circulating currents, and with respect to them, the Jacobs-Shupert boiler presents superior advantages, for the water space about a Jacobs-Shupert firebox presents broad, unobstructed vertical channels which in the matter of form and dimensions have no counterpart in the radial-stay boiler.

The conclusion as drawn from analysis and experiment is to the effect that with reference to circulation the Jacobs-Shupert boiler is at no disadvantage as compared with the radial-stay type, but on the contrary possesses elements of distinct superiority to that type.

The superior strength of the Jacobs-Shupert boiler under low-water conditions has been abundantly demonstrated by experiment. In the progress of the tests each boiler in turn was put under steam. Its draft was adjusted to give an evaporation of approximately 10 pounds of water per foot of heating-surface per hour. Upon signal, the injectors were shut off and the delivery of feed-water ceased. Thereafter the water-level steadily declined, but the fire was not checked. The purpose was to maintain all the general conditions the same for both boilers, and the data show that this purpose was satisfactorily achieved.

In the test of the Jacobs-Shupert boiler, the water-level receded to the bottom of a special water-glass 25½ inches below the level of the crown sheet in 34 minutes after it had passed the level of the crown-sheet, but there was no failure or serious leak. The extent of the submerged heating-surface continued steadily to diminish and the steam-jet from the exhaust which made heavy demands upon the boiler began to reduce the steam pressure, until finally when the water had fallen nearly 40 inches below the crown-sheet

and the pressure had been reduced to 50 pounds, 53 minutes after the water had fallen to the level of the crown-sheet, the test was ended. The Jacobs-Shupert boiler had been boiled nearly dry and no failure had occurred. An inspection of the boiler after the test showed all the usual effects of overheating except that the firebox was intact. Three-quarters of the tubes were out of water and were sagged from the effects of the heat. Several tubes had collapsed. The crown and sides of the firebox for half their height presented the scale and color of newly heated metal. There was some change in the curvature of sections, but there were no local pocketing and no leaks between sections. The integrity of the firebox was complete, and so far as its condition was concerned, the boiler at the conclusion of the test might have been refilled and operated. Probably no other type of locomotive boiler now in common use could have withstood such a test.

The radial-stay boiler was subjected to a similar test. The conditions of operation imposed were identical with those which had prevailed during the test of the Jacobs-Shupert boiler. Seventeen and three-quarters minutes after the water in glass had fallen to the level of the crown-sheet, when its level was 14½ inches below the crown, the boiler failed. One-half the crown-sheet came down. The rear end of the boiler was lifted from its foundation and the brickwork making up the furnace construction was scattered in all directions over a radius of 150 feet. An examination of the boiler showed only the upper row of tubes to have been out of water, and these had not been heated sufficiently to make them sag. The lowering of the water-level had not been sufficient to allow the side-sheets or the back sheet or the tube-sheet to take on evidences of over-heating, facts which suggest the brevity of the interval during which the crown was actually exposed, and yet in the interval, the crown of a new boiler came down with explosive effect. The failure was complete; the boiler had broken away from all its fastenings, property in its vicinity was disturbed, and the boiler itself left incapable of rendering further immediate service.

A comparison of these statements shows conclusively the superior strength and safety under low-water conditions of the Jacobs-Shupert boiler.

The general conclusions justified by the work are to the effect that the design of the Jacobs-Shupert boiler is the result of a carefully studied development of pre-existing practice; that the design easily admits of a grade of workmanship difficult to attain in the construction of pre-existing types of locomotive boilers; that those features which are peculiar to the new construction are such as tend to reduce cost in maintenance; that the evaporative efficiency of the Jacobs-Shupert boiler is the same as that of a radial-stay boiler of the same dimensions; that the steaming capacity of the Jacobs-Shupert boiler is, in general, the same as that of a radial-stay boiler, but that it may be forced without danger of injury to higher power; that the Jacobs-Shupert boiler presents nothing in its internal construction which can interfere with the usual movement of water over the heating-surfaces, and that in the matter of circulation it possesses some advantages when compared with other types of locomotive boilers; that the superior strength of the Jacobs-Shupert boiler under low-water conditions permits it to endure overheating without failure for long periods of time, where the normal radial-stay boiler quickly fails; and that where the overheating is so severe that it can be resisted, the result will be a blow-out and not a disastrous explosion.

NEW YORK CENTRAL SAFETY WORK.

The New York Central Lines have made a marked decrease in the number of accidents since the institution of the movement for greater safety, under the direction of George Bradshaw, general safety agent. The record of injuries in the car and locomotive shop of the various roads of the system for two periods of 1912 are as follows:

Shops	Number employed for one injured June-Aug.	Sept.-Nov.	Per Cent. Decrease
Beech Grove	45.0	57.0	26.7
Bellefontaine	301.0	808.0	168.4
Bucyrus	40.0	40.0	none
Collinwood	12.5	15.3	22.4
Elkhart	25.4	37.3	46.8
Englewood (Chicago)	9.4	16.0	70.2
Root St. (Chicago)	30.2	56.7	87.7
Gibson	19.8	38.2	92.9
Kankakee	38.1	29.4	3.4
Kenton	66.0	81.0	22.7
Lima	36.5	47.0	28.7
Mattoon	53.4	70.6	32.2
Mt. Carmel	20.2	22.6	11.9

It will be noted that these figures are based on the number of men employed for each one injured, and that a very marked decrease is shown for the September-October-November period over the June-July-August period, although it is well known that a larger percentage of accidents usually happen in the fall and winter months on account of the decreased amount of daylight at that time. In other words, the favorable decrease in the number of employes injured has been made in the face of unfavorable natural conditions and can be attributed only to the increased care on the part of officials and employes for the prevention of injuries.

IT CAN BE DONE.

Somebody said that it couldn't be done,
But he, with a chuckle, replied
That "maybe it couldn't," but he would be one
Who wouldn't say so till he'd tried.
So he buckled right in, with the trace of a grin
On his face. If he worried, he hid it.
He started to sing as he tackled the thing
That couldn't be done, and he did it.

Somebody scoffed: "Oh, you'll never do that;
At least no one ever has done it."
But he took off his coat and he took off his hat,
And the first thing we knew he'd begun it;
With the lift of his chin, and a bit of a grin,
Without any doubting or quiddit;
He started to sing as he tackled the thing
That couldn't be done, and he did it.

There are thousands to tell you it can not be done,
There are thousands to prophesy failure;
There are thousands to point out to you, one by one,
The dangers that wait to assail you;
But just buckle in with a bit of a grin,
Then take off your coat and go to it;
Just start in to sing as you tackle the thing
That "can not be done," and you'll do it.

—*Unidentified.*

AN ONLOOKER shook his head as he watched a steam shovel bite off earth by the ton. He said: "It throws men out of work; it loads those cars faster than a hundred men with picks and shovels could do it."

But another onlooker answered:

"See here, mister, if it would be better to employ a hundred men with picks and shovels on this job, wouldn't it be better still, by your way of thinking, to employ a thousand men with forks and tablespoons?"—*Rio Grande Employes' Magazine.*

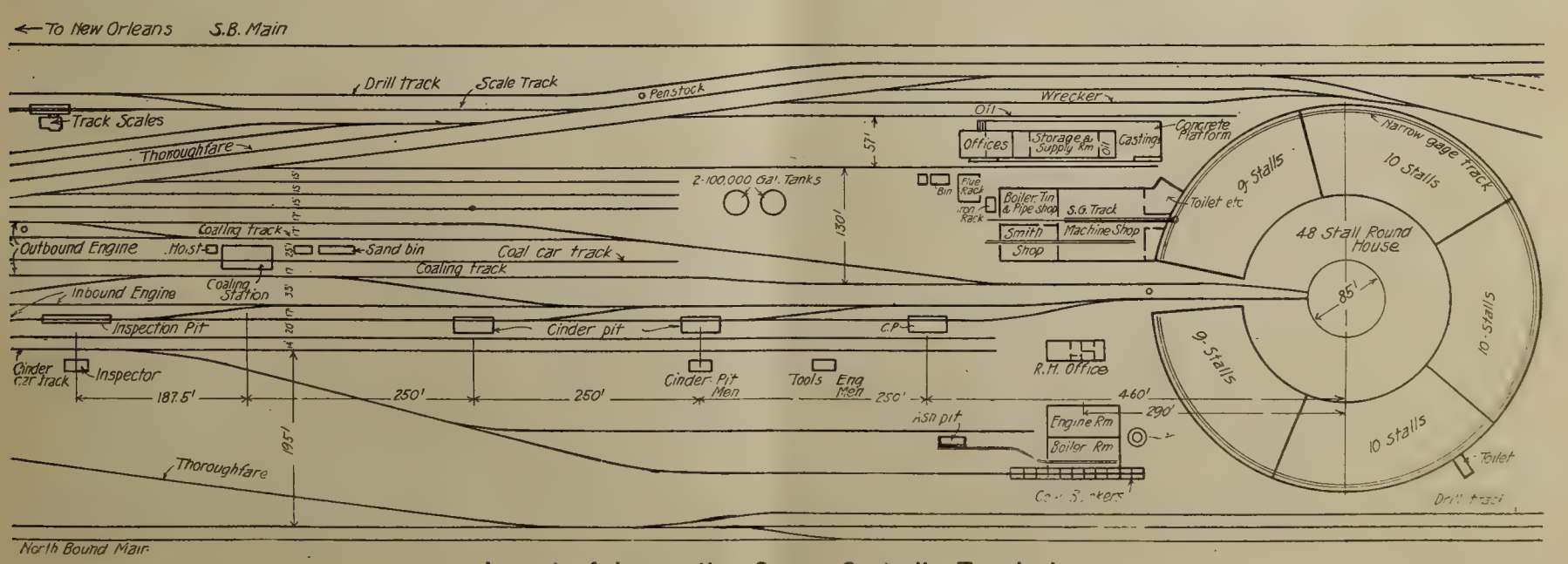
Centralia Terminal, Illinois Central R. R.

The Illinois Central R. R. is just completing at Centralia, Ill., one of the most modern and up-to-date terminals in the country and one which will result in much greater efficiency in handling freight bound for Chicago and points north and west. Centralia is about 250 miles south of Chicago, on the main line of the Illinois Central to Memphis and New Orleans. At this point a division branches off the main line and continues up through the center of Illinois to Freeport, where it strikes the line running west from Chicago to Omaha. efficiency of the entire system, located, as it is, at a vital point.

The old facilities at this point were inadequate and were incapable of expansion, being hemmed in by Centralia and its northern neighbor, Central City. So the new yards and terminal were located just south of Centralia, covering approximately two hundred and seventy-five acres in the shape of a strip 500 feet wide, in addition to, and on the west side of, the old right of way. The yards were all placed between the main tracks, with

General View of Centralia Terminal, Locomotive Group.

All the business from New Orleans, the Birmingham division, the Kentucky division, together with the heavy coal business of Southern Illinois, arrives at Centralia on its way north. It is therefore, an opportune place to classify freight so that it may move forward to its destination in full train lots, requiring no further switching. To facilitate this movement was the purpose in view. Thus full trains are made up for the various Chicago yards and also for Freeport, Omaha and other points reached by the branching division. So it can be seen that the installation of this modern terminal will greatly increase the the idea of permitting free interchange between them. The yard is a hump yard, containing a receiving, classification and departure yard for northbound traffic, together with a switching yard for southbound traffic. The southbound yard has been so laid out as to provide for future expansion; in fact the whole terminal has been laid out with this view. The complete development of the north bound yard provides for a capacity of 5,380 cars with 69 tracks. The yards were completed late last summer, the work being started in 1911. The illustrations showing the layout of the buildings do not include the entire



Layout of Locomotive Group, Centralia Terminal.

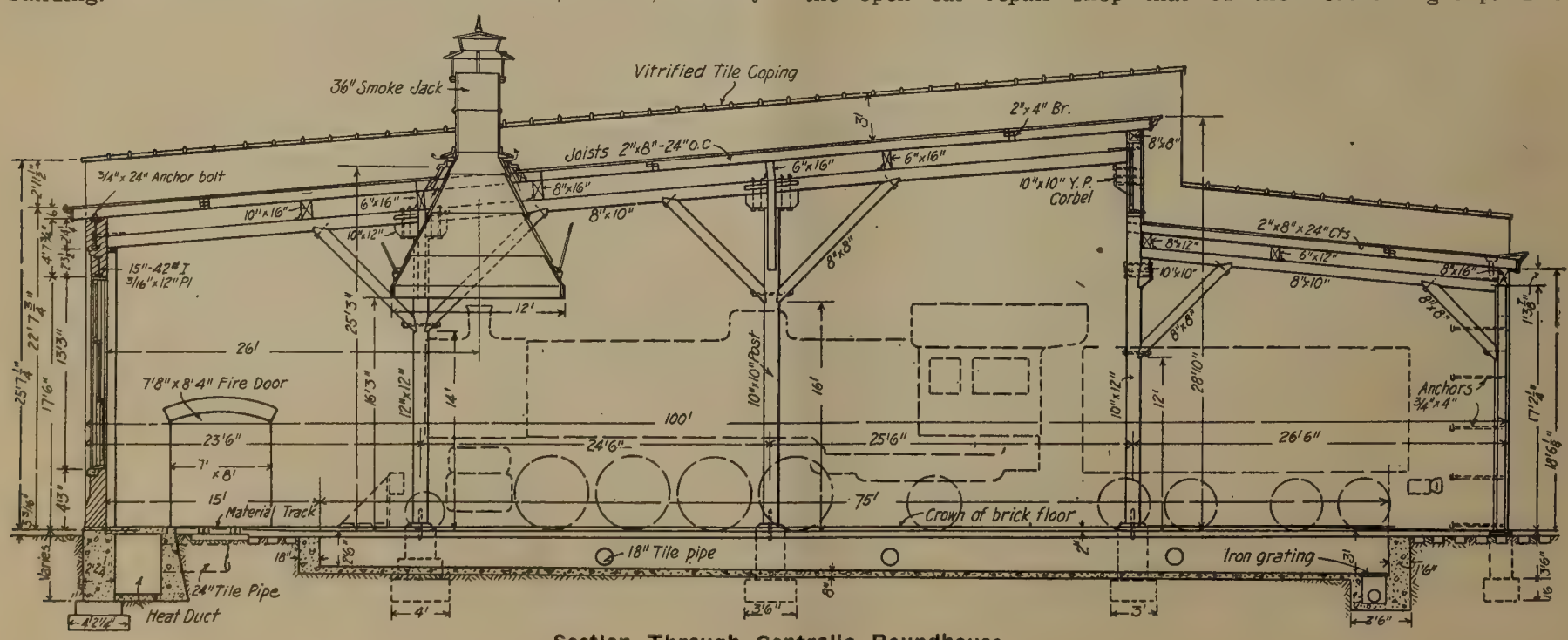
Interior of Centralia Roundhouse. Note Radiators Between Windows.

yard system. Work on the new terminal buildings was started last year and, as has been stated, they are now ready for use. Following is a list of the buildings which have been constructed, with their dimensions:

Power house, 80 ft. by 70 ft.
Roundhouse and erecting shop.
Machine, smith, boiler, tin and pipe shop, 171 ft. by 82 ft.
Open Car Repair Shop, 90 ft. by 500 ft.
Wood Mill.
Office, storehouse and oil building, 31 ft. by 173 ft.
Finished lumber shed, hand and push car locker, lavatory and tool room, 103 ft. by 35 1-2 ft.
Paint storage building, 32 ft. by 18 ft.
Car repair and inspector's shanty
Ice house, 45 ft. by 145 ft.
Roundhouse and R. F. E. office and enginemen's locker room building.
Scale house and office.
Building for material storehouse, division store room, casting and storeroom, air brake and pipe shop, smith shop and car wheel room.
Toilet houses (three).
Coke and coal storage for blacksmith shop.
Storehouse for engineer's tools, oil cans, etc.
Yard master's office.
Assistant yard master's office.
Signal power house, containing two compressors.
Inspector's building and shelter for cinder pit men.
Coaling station.

There are also three concrete cinder pits, one 75-foot inspector pit, and two 100,000 gallon tanks.

These buildings are in two groups, the roundhouse and machine shop constituting the nucleus of the southern group and the open car repair shop that of the northern group. The



Section Through Centralia Roundhouse.

Interior of Erecting Shop Section of Roundhouse at Centralia.

relative location of the buildings in each group is shown in the two drawings; the distance between the two groups being about 2,500 feet. We will first take up the buildings of the southern group.

Locomotive Department Group.

The larger buildings of this group, including the roundhouse, machine shop, office building and storehouse and power house are of brick construction and, with the exception of the roundhouse, have roofs composed of 3-inch reinforced concrete slabs, which is in accordance with recent practice on the Illinois Central. This concrete roofing is covered successively with hot pitch, 2 ply tarred felt, another coat of pitch followed by 2 ply tarred felt, and the whole covered with another coat of pitch mixed hot with gravel. These buildings are all equipped with Fenestra steel window sash, and louvres and windows are operated by the Peerless tension operating device. The steel roof trusses and columns are well shown in the interior views of the machine shop and erecting shop.

The roundhouse consists of 48 one hundred foot stalls and is divided into 5 sections by fire walls, one section of which is used as an erecting shop. This section consisting of nine stalls is of somewhat different construction from the rest of the roundhouse as may be seen by comparing the interior views and has a clere story arranged in such a manner as to secure a maximum amount of light. This section has 7 driver drop pits, 2 truck pits and is equipped with a 7½ ton crane of 52 feet span. This, as well as the cranes used elsewhere, is a Whiting.

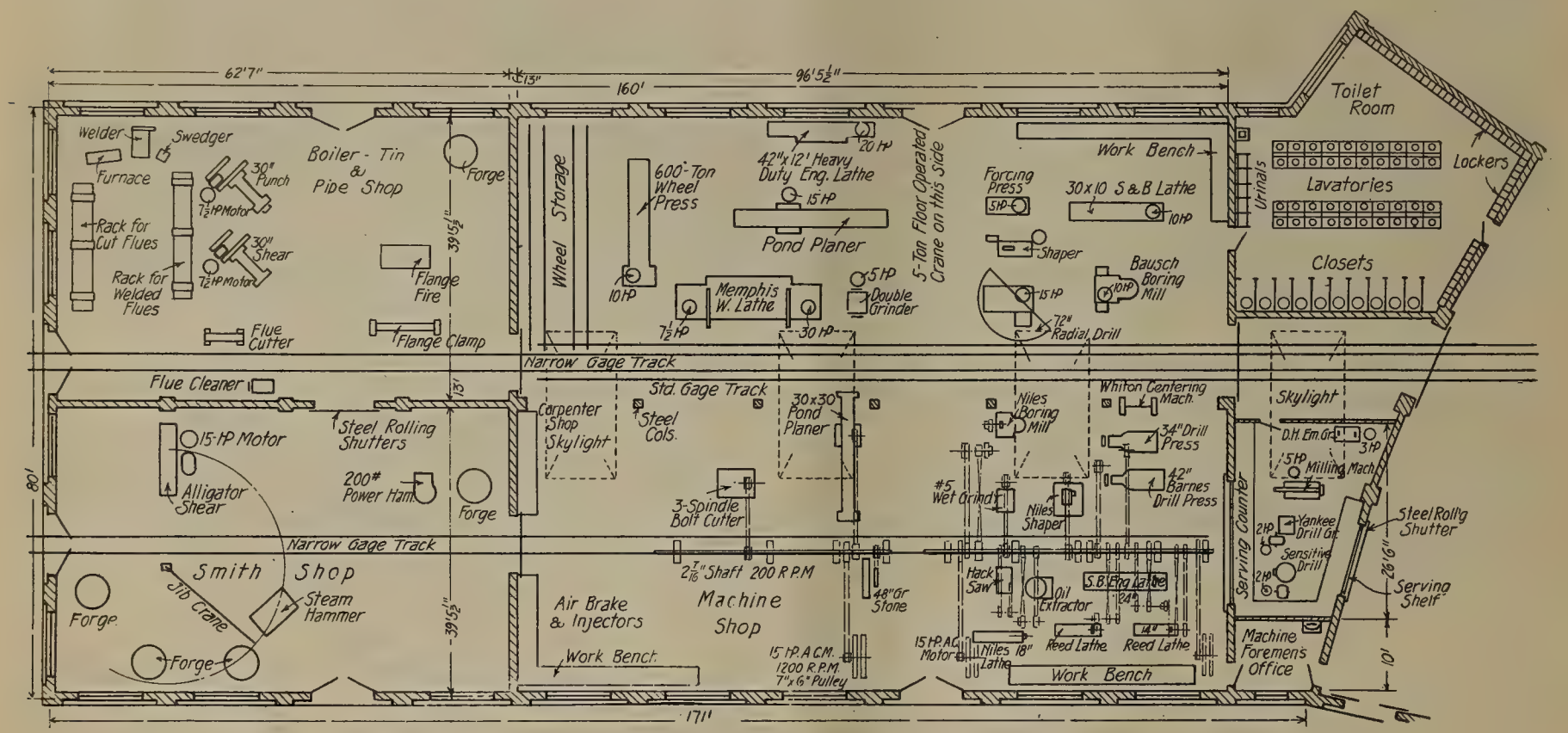
A 24 inch material track encircles the roundhouse just inside the outer wall and connects by means of turntable to similar tracks in the machine shop building adjacent. In addition to the customary connections at each pit, there is at each pit a box for plugging into a three-phase power circuit, thus enabling the use of portable lathes and other tools. This is a modern feature and indicates the up-to-dateness of this terminal. Another striking feature is that although the outer wall is of brick construction, it is constructed in such a manner that an engine going through will only carry out a limited portion of the wall and window framing. This is accomplished by placing in the wall at either edge of this portion two steel columns whose ends are lightly held in place on two flat plates, so that in case an engine goes through the damage does not extend beyond these columns. The openings in the fire walls can be closed by sliding doors equipped with Wilcox hangers. The 85 foot

Interior of Centralia Machine Shop.

turntable is equipped with a Nichols tractor. Smoke jacks are of cast iron. A 3 inch steam line and a 4 inch air line is run through the house with drops at each post.

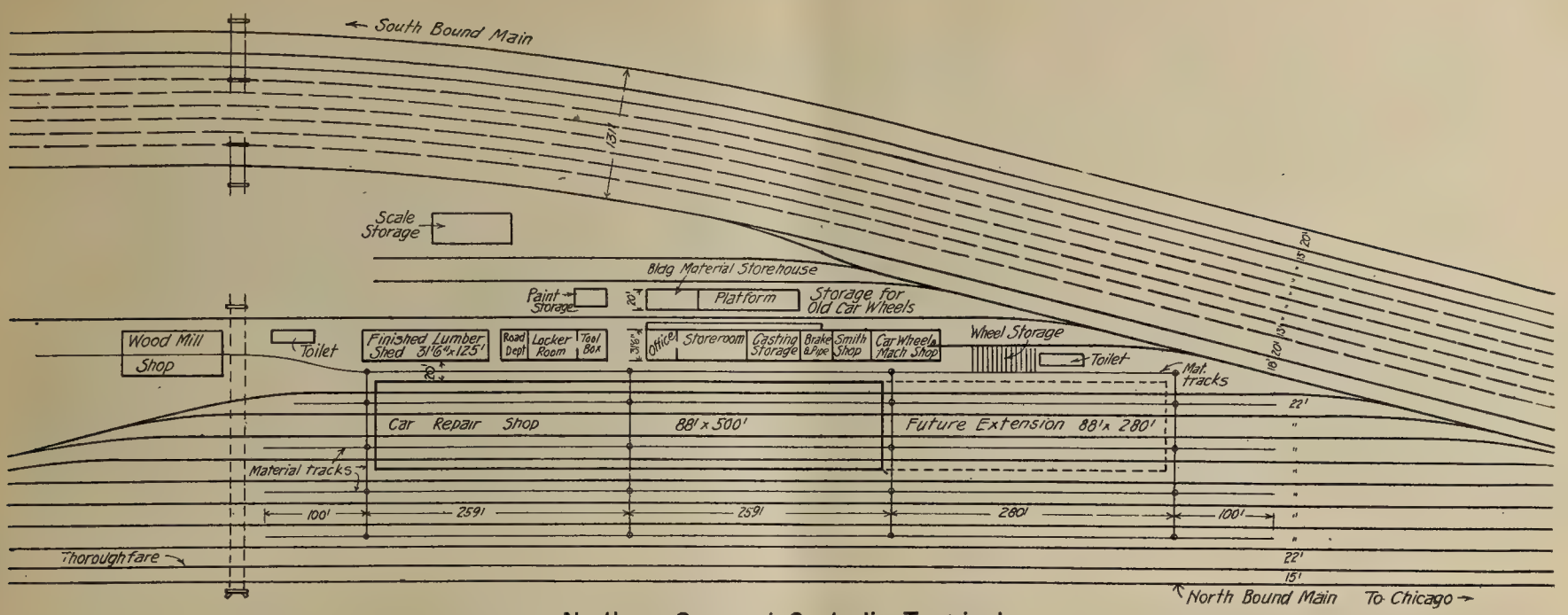
The power house is equipped with 4 Sterling boilers with provision for the addition of a fifth. They are 250 horsepower. The coal bunkers open through the wall as indicated in the illustration. The grates are designed to carry an overload of 25 per cent continuously. A narrow gage track for handling ashes passes in front of the boilers and out to the boiler ash pit. Under this track is a concrete trench for the future installation of a pneumatic ash handling system. The engine room contains two 250 K. V. A. turbo generators with provision for the addition of a third, two 1,000 cubic feet Laidlaw-Dunn-Gordon air compressors, an Alberger fire pump, the necessary exciters and a Westinghouse ten-panel switch board. There is also a Jeanesvile Iron Works centrifugal pump connected to a Terry turbine, for circulating the hot water for heating the car shop, 2 American vacuum pumps and 2 Blake-Knowles boiler feed pumps. The engine room is equipped with a 5 ton crane and space has been allowed at one end for the installation of a boiler washing system. The stack is a Weber concrete chimney 204 feet in height and lined for the first 70 feet with radial fire blocks, built without taper and independent of the chimney thus providing an air space between it and the chimney. It extends through the flue opening and connects with the flue lining, and is guaranteed to withstand 1,500° F. A 2 inch pyrometer and a 4 inch draft gage with all necessary connections has been placed in the chimney. There are to be five steel transmission towers on concrete bases between the power house, machine shop and storehouse.

The machine shop building adjoins the erecting shop portion of the roundhouse and contains, besides the machine shop, the boiler, tin and smith shops. The layout of the machine tools in this shop together with the makes of same, can be seen by referring to the plan view drawing. This also gives the various dimensions. It will be seen that both a standard and a narrow gage track enter the machine shop portion, and that half of the machine shop is covered by a five-ton, floor-operated crane. The machines under this crane have individual motor drives, those in the other half being driven from a line shaft. The doors



Plan of Machine Shop Building, Showing Layout of Machine Tools.

Office Building and End of Machine Shop, Centralia, Ill.



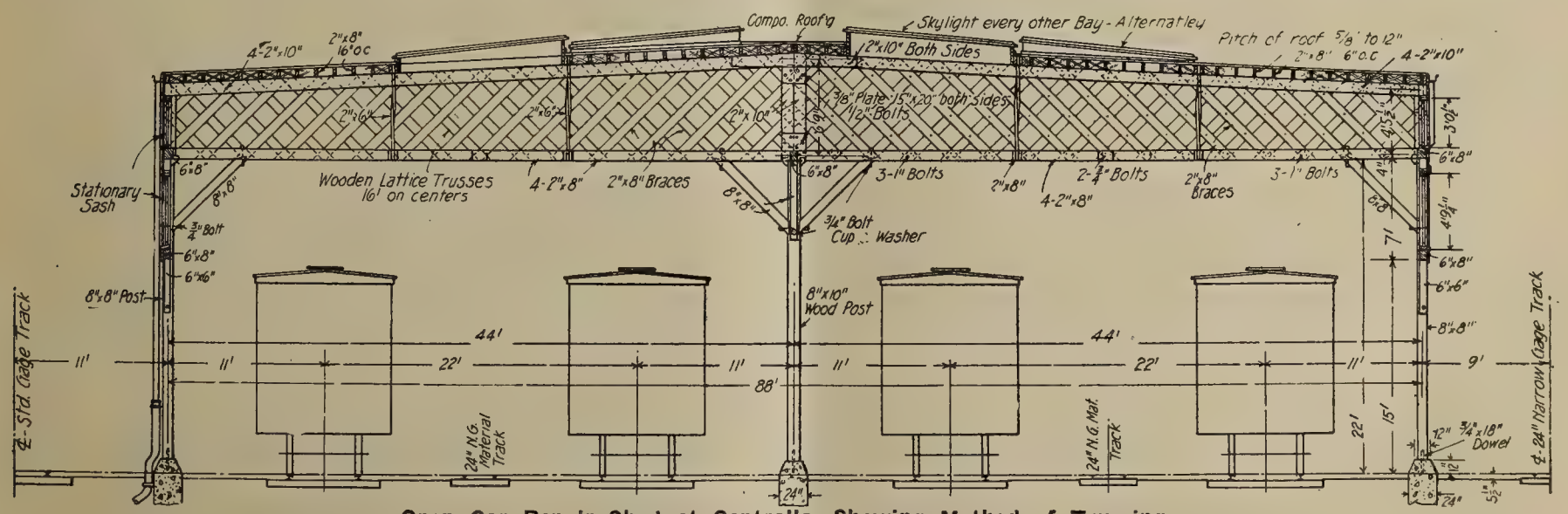
Northern Group at Centralia Terminal.

connecting the various shops in this building are provided with Kinnear steel rolling shutters, which can be operated from either side, and are connected to the lintel by fusible links. The building is well supplied with skylights and ventilators, and between the shop proper and the roundhouse is a toilet room equipped with 47 steel lockers, which shows that the Illinois Central considers the comfort of its employes necessary in promoting efficinecy.

On the first floor of the office and storehouse building are the master mechanic's and storekeeper's offices, together with offices for the clerks. Above this is the record room and the engine men's rest rooms. The remainder of the building is one story and back of the offices is the storage and supply room. At the other end of the building, and separated from the storage room by a brick wall, is the oil and waste room. This room, as well as the storeroom, has a concrete floor, and the roof beams throughout are encased in concrete. In the oil room are 10 Bowser oil pumps of the one-gallon size and three Bowser power pumps. The latter are operated by motor and are for pumping out kerosene, car oil and fuel oil for barrel-filling purposes. The oil supply is located in the basement of the oil house. A concrete castings platform surrounds a portion of the storehouse building.

A building near the power house contains the roundhouse office, the road foreman of engine's office and the engine men's locker room and registry room. The locker room is equipped with the most modern sanitary fixtures available, has 248 steel lockers and two showers. This building has a slate roof. South of the machine shop building are located the two 100,000 gallon tanks. There are a number of small buildings scattered about, such as cinder pit shelters, yard master's office, scale house, etc. The yard master's office contains also a lunchroom and a restroom with 26 lockers.

The icehouse has a capacity of 4,000 tons and is divided into four compartments of 1,000 tons each. The construction of the walls, starting at the outside, is as follows: Siding, two-ply Giant paper, two-inch furring strips, ½-inch Flaxlinum, two-ply Giant paper, 1x6-inch sheathing, 1x5½-inch air space, 1x6-inch sheathing, two-inch cork and ½-inch plaster. The floor is covered with 2x6-inch planks with a one-inch between. Prepared roofing is used. The icing platforms will accommodate eight refrigerator cars at a time, and the icing mechanisms are operated by motors placed in the roof gables.



Open Car Repair Shed at Centralia, Showing Method of Trussing.

The coaling station is a 600-ton skip hoist type, constructed by the T. W. Snow Construction Company of Chicago.

Car Department Group.

The central unit of this group is the open car repair shop, 90x500 feet. This is of rather an unusual type, there being but two roof slopes instead of four. This does away with the undesirable center drains and provides a roof much neater in appearance and of greater durability. It is trussed with wooden lattice trusses placed on 16-foot centers, as is shown in both the photograph and the line drawing. The posts are placed on a concrete foundation. The first 15 feet is open and the next seven feet enclosed, although this latter space is prac-

Finished Lumber Shed and Open Car Repair Shed.

tically all window space. The roof is plentifully supplied with skylights. There are four standard gage tracks running through the building, two on either side of the rows of posts down the center. There are also two material tracks, one between each set of standard gage tracks.

Ranged along the west side of the car shop are the attendant buildings, such as the wood mill, finished lumber shed, car wheel shop, etc. A glance at the layout drawing of this group shows that these buildings are so arranged that the movement of the material is continuous from one shop to another. The rough lumber is stored in the space south of the wood mill. From here it is taken into the wood mill and thence passes north to the finished lumber shed which is near the end of the car repair shop. At the north end of the car shed is the storehouse and car wheel shop. The wood mill has a concrete roof with two 36-inch ventilators, a concrete floor and Fenestra window sash. There is a narrow gage material track through the center. The following machines have been installed, all of which have individual motor drive:

Planer .....50 H. P. motor, 900 R. P. M.
Wood Worker .....7½ H. P. motor, 1800 R. P. M.
5x24-in. Planer .....7½ H. P. motor, 1,800 R. P. M.
Rip Saw .....7½ H. P. motor, 1,800 R. P. M.
Gainer .....15 H. P. motor, 900 R. P. M.
4-Spindle Boring Machine.....10 H. P. motor, 900 R. P. M.
Automatic Cut-Off Saw.....15 H. P. motor, 600 R. P. M.
Mortiser .....15 H. P. motor, 1,200 R. P. M.
Band Saw .....5 H. P. motor, 1,200 R. P. M.
Turning Lathe .....2 H. P. motor, 1,200 R. P. M.
48-in. Grind Stone .....3 H. P. motor, 1,200 R. P. M.
Knife Grinder .....2 H. P. motor, 1,200 R. P. M.
Saw Sharpener .....2 H. P. motor, 1,200 R. P. M.

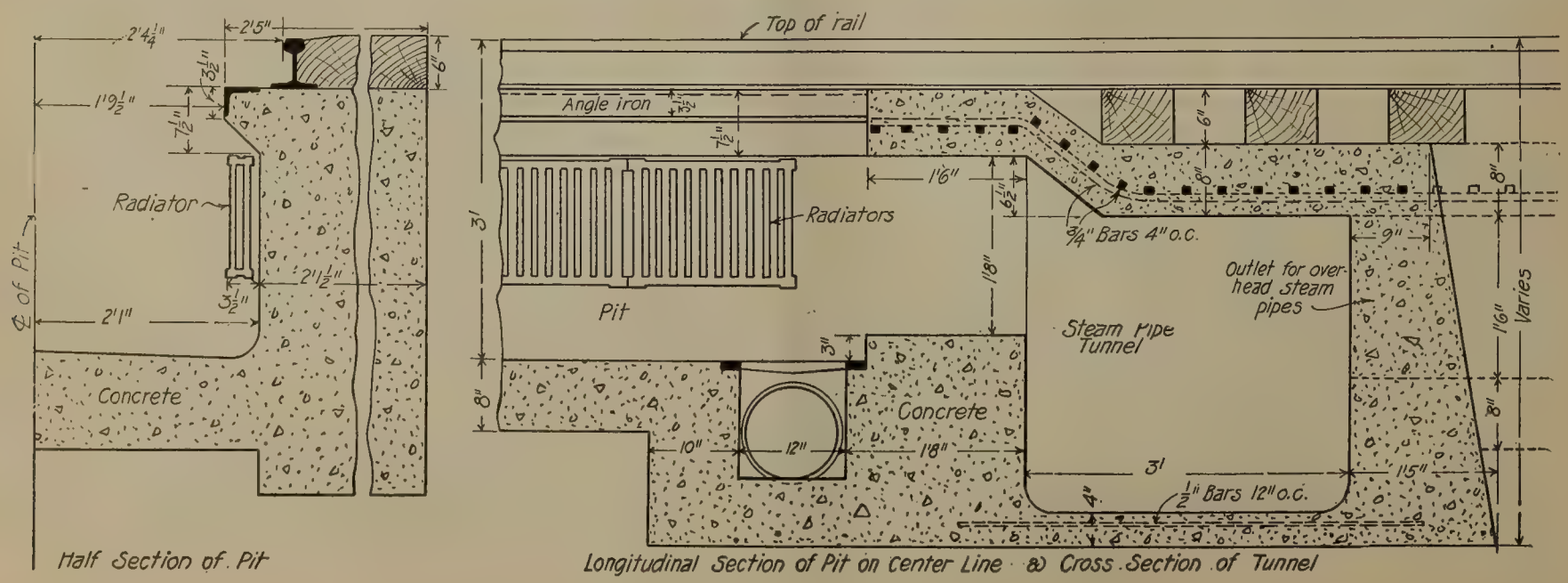
The blacksmith and wheel shop contains the following equipment:

2 Forges.
100-lb. Power Hammer.....2 H. P. motor, 1,200 R. P. M.
Plate Forge.
Face Plate.
D. H. Bolt Cutter.....3 H. P. motor, 1,200 R. P. M.
48-in. Grind Stone.....3 H. P. motor, 1,200 R. P. M.
36-in. Drill Press.....3 H. P. motor, 1,200 R. P. M.
D. H. Grinder .....3 H. P. motor, 1,800 R. P. M.
Journal Lathe .....5 H. P. motor, 900 R. P. M.
Wheel Press .....7½ H. P., 900 R. P. M.
Car Wheel Boring Mill.....10 H. P. motor, 900 R. P. M.
Axle Lathe .....15 H. P. motor, 900 R. P. M.

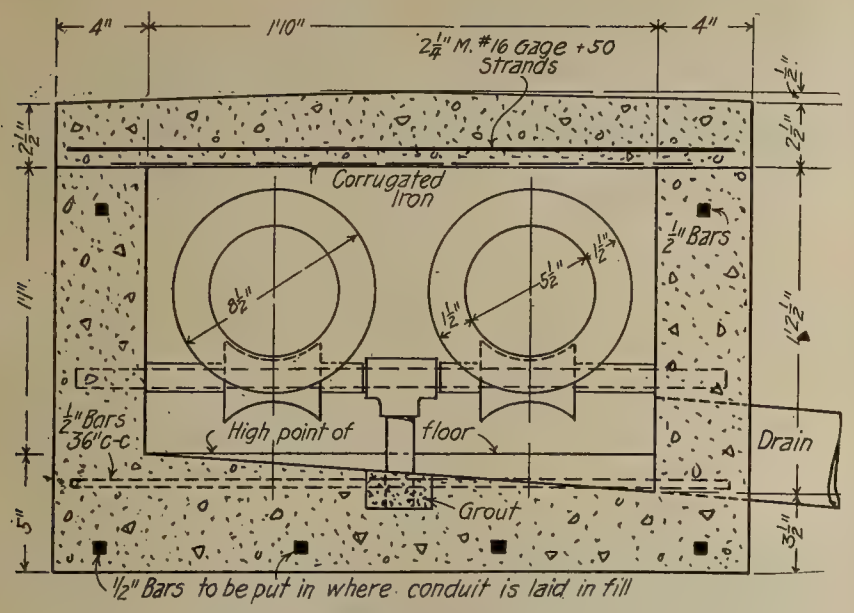
There is also in this group a paint storage building, office and division storehouse, two toilet houses and car wheel storage spaces.

Heating.

The heating arrangement used at Centralia is very interesting, a number of new features being used. In the first place two systems are used; steam heat for the southern or locomotive department group and hot water for the northern or car department group. As has been stated, the distance between these groups is about 2,500 feet, and one of the reasons for adopting hot water for the northern group was on account of the difficulties to be encountered in connection with steam condensation and traps, the intervening ground being rather uneven in character. The two hot water pipes running to the car end were placed in a concrete box, which was fitted with a concrete cover. They were laid on expansion rollers, as shown in the sketch,



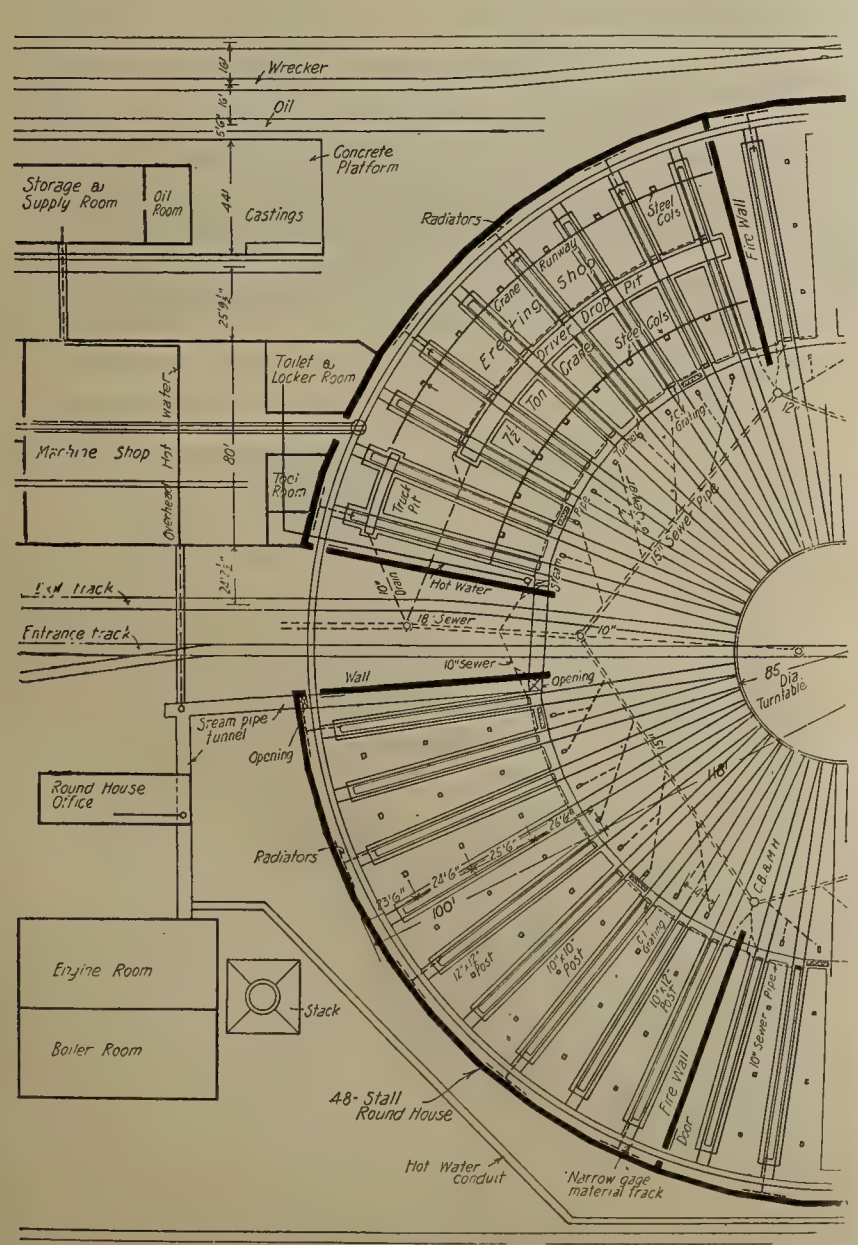
Sections Showing Roundhouse Pit Radiation and Steam Pipe Tunnel.



Section of Hot Water Pipe Conduit.

and two expansion loops were placed in the 2,500-foot line.

From the power house to the roundhouse there is a concrete tunnel carrying the steam and other pipes, and a conduit continues on to the machine shop and office building, carrying steam pipes and hot water pipes for washing and other purposes. This tunnel follows the inner circle of the roundhouse. As may be noticed in the photographs, cast iron radiators are placed between the roundhouse windows and extend up some distance between them. A riser is taken off from the tunnel steam pipes at a point near the outer circle, as they enter the building. This steam pipe continues around the outer circle and may be noticed in the photograph, just under the roof. From this pipe drops are taken to the wall radiators, and from these the steam passes into the pit radiators and thence to the steam tunnel at the inner circle. The radiators in the pits are also of cast iron and are placed in a recess. The drawing shows the placing of the pit radiators and also a section of the steam pipe tunnel. At frequent intervals around this tunnel there are oblong manholes with cast iron covers 8 feet in length. These allow the replacing of sections of pipe if necessary. Kehm Bros. Co., of Chicago, had the contract for the heating.



Plan of Roundhouse Showing Diagram of Heating and Sewer Pipes.

Lighting.

Tungsten lights are used almost entirely in lighting, being used in units of from 40 to 500 watts. They are used singly, except in the office, where clusters are used. In the roundhouse there are three lights to each stall, one 100 watts and two 250 watts, each light having a Benjamin reflector and being dropped from the ceiling. The drop pits are illuminated by lights placed in recesses. The lights above the crane-way in the erecting shop are 500 watts and the 500-watt tungstens are also used in yard lighting.

General.

Fire protection is provided for by a motor-driven centrifugal pump and hydrants in the usual manner. Water is supplied by the city of Centralia. There are both sanitary and storm water sewers, the latter emptying into a nearby creek, while the contents of the former is taken care of by a septic tank. A McFell Electric Co. fire alarm system is installed with pull boxes at various points and an indicator in the power house. All buildings are connected by a telephone system, and as has been said, the Centralia terminal of the Illinois Central is an exposition of everything modern in terminal design and equipment. Especially to be commended are the provisions made for the comfort and cleanliness of the men, not only by locker and toilet accommodation, but in the lighting and ventilation of the buildings. It will bring to the Illinois Central an increase in the working effiicency. T. S. Leak & Co., of Chicago, were the general contractors. For the data and illustrations given above we are indebted to F. L. Thompson, engineer bridges and buildings; J. A. Taggart, architect, and Willard Doud, shop engineer, of the Illinois Central.

TARE WEIGHT MARKING DEVICE.

By F. C. Maegly, A. G. F. A., A. T. & S. F. Ry.

For nine or ten years past, my office has had charge of the scales and weighing on Santa Fe System Lines, under authority issued by the two vice-presidents in charge of operations and traffic.

In the effort to get cars light weighed and restencilled, we undertook to eliminate the delay, between the scale and the release of the restencilled cars. All are familiar with the causes contributing to that delay. The reports obtained from our various restencilling stations on several general inquiries showed that the detention averaged from one to three days, due to prevailing causes and local conditions.

We first obtained authority from the general managers to have the weighmasters paint out the old tare and restencil the new, but that plan proved objectionable for various reasons and was abandoned.

Later on a metal rack and filler was devised, to be attached to system freight cars. The metal filler was formed so as to hold the tare weight numbers and symbols, thus enabling the weighmasters to correct the tare weights without the use of paint and without delay to cars or switching crews.

The metal filler is secured in the rack by means of a self-locking car seal. Some of these car seals are broken by meddlesome persons, particularly after they have been on the car for a long period. The ordinary car seals rust and

break easily after being exposed to the weather for a long time.

The difficulty just mentioned led to the adoption of an improved device; a tare weight holder which is self-locking and requires the cutting of the tare weight card, or metal sign, in a certain, conspicuous place, to open the same and make the necessary substitutions.

The improved device, number 2, is secured to the side of the car by means of six flat-head screws, one inch and one-half long, or by rivets. The parts susceptible to rust or corrosion are made of brass; the balance is protected by baked enamel. The holder is placed, preferably over the first three figures of the stencilled tare weight.

We have experimented with various qualities of card board in the old device which has been in use on thousands of cars for more than two years. Certain qualities of these cards are legible after the cards have been exposed to all weather conditions for a period of one year and nine months; but to further safeguard that feature, metal signs may be used.

The improved device, number 2, does away with the car seal baffles the meddler and enables the official weigh master to keep the cars supplied at all times with legible fare weight cards or metal signs. If., however, the marks are defaced or illegible, instructions require replacement and report of the fact to the car accountant. If the tare weight signs on any car should be missing from the holder, the agent merely wires the car accountant who furnishes proper tare weight marks or re-light-weighing of car. Or if the car is at a track scale station, the agent has authority to light-weigh if necessary and re-mark it.

The weighing station places back of the card or metal signs, a carbon leaf of the original scale ticket. The official weighing stamp, signature or other authenticating mark of official weigher is noted on back of tare weight cards, where combination card-board is used, or where a weighing station has no scale tickets, the weighmaster is required to write on back of card or place underneath a signed slip showing

Fig. 1—Back and Front Views of Tare Weight Marking Device.

car number, weighing station, date weighed, new and old light-weight and signature.

This plan of marking tare weights on freight cars fixes upon the official weighmaster entire responsibility for all tare weight marks applied. The car department's paint track or stenciling force is thus relieved of an irregular, uncertain and extensive service, and the delays to cars and switching crews are eliminated.

The front and back of the improved device is shown in Figure 1. Figure 2 shows a weighmaster's layout of combination three-digit signs, cardboard or metal, arranged in card index form. A table six feet long and three feet wide will accomodate such a layout covering supply of cards sufficient for 5,000 cars. A like supply of metal signs would occupy considerably less space.

The supply for 500 cars for the weighmaster's layout of individual tare weight signs and symbols occupies a space of approximately 8x14x20 inches. Where individual signs are supplied, the plan is to show the denomination of each card; namely—whether "Ten Thousands," "Thousands" or "Hundreds" digits. In so doing, the weighmaster's layout would occupy two and one-half times the space noted above.

Figure 2—Weighmaster's Layout of Signs.

Locomotive Lubrication

By W. W. Lemen.

Foreword.

The writer of this article desires the reader to know that he is employed by the Galena Company. He is not a theorist, but devotes his time and thought daily to the subject discussed in this article. In addition to the knowledge of the subject obtained since his employment with the Galena Company, he has had more than twenty years' railroad experience in locomotive construction and maintenance, as well as designing, experimental and investigating work.

Today "Locomotive Lubrication" and "The Galena Company" are analogous terms, and while the writer shall endeavor to avoid any appearance of using the privilege accorded by this article to advertise the Galena Company, he will not be guilty of circumlocution in dealing with the facts; but a reference to the Galena Company will be plainly made when it is obvious that such is the company referred to.

The prevalent fashion is that the operations of successful business organizations be made public. This demand of the public has been rather on the order of our plain spoken friends, who only tell us of our faults and keep conspicuously quiet regarding any virtues we may possess. Fair play demands that if the faults or mistakes, both real and apparent, be published, then the public should also be informed of what the same organization may have accomplished in the interest of human progress; so that the public may have the opportunity, at least, of weighing the two in the balance.

The recent reports of the committees on lubrication of our foremost mechanical associations, and the papers read before clubs and societies in recent years, have all (without exception), unequivocally accorded to one and the same oil company the full credit for the great results accomplished toward efficient and economical locomotive lubrication. Why not openly bestow honor where it is due, by plainly naming the company entitled to this credit.

This whole exordium may, to the minds of some readers, take the form of an encomium to the Galena Company. The writer can only request that it be taken as a mere statement of facts. The Galena Company, or its materials, need no advertising, and its methods of doing business do not require defending; as both the materials and methods have been thoroughly tested by time, and have been found to more than meet all requirements.

The principle of lubrication is as old as man; and as he had to use but little ingenuity in discovering this principle and its purpose, it being exemplified in the articulations of his own frame, it is fair to assume that he acquired this knowledge at a very early period. Max Verworn, an eminent writer on physiology, writes that early man discovered many simple phenomena by self-observation.

It is well known that the ancients possessed at least some simple types of machines, for the reason that they raised many great stones to a considerable height in completed works, after having transported them great distances from the quarries whence they were taken. And it cannot be doubted that the engineers of King Khufu, in building one of the great pyramids 4,000 years B. C., required the rubbing surfaces of the machines and implements in use to be lubricated, so as to be used more effectively. Neither can it be doubted that even at that early date the efficacy of various lubricants was discussed. Although some knowledge of this, one of the most important essentials to mechanical progress, has been possessed by man for many years, the subject has not been given the attention by the engineer and man of science that its importance would justify. However, science and the mechanic are greatly indebted to some earnest and very able students of the subject for considerable practical information and working data, some of which has taken the form of empirical formulae.

The efficiency of a machine is measured by the quantity of work obtained, by dividing the amount of useful work performed by the gross work of the machine; and experience has taught that friction is the principal cause of loss of energy and waste of work in machinery. Also that waste energy is reduced to a minimum by a proper choice of rubbing surfaces and by the best lubrication.

The compound friction of lubricated surfaces, or friction due to the action of surfaces of solids partly separated by a fluid, is observed in all cases in which the rubbing surfaces are lubricated. In such instances the solids are not completely separated by the liquid film interposed between them, but partly rub on each other and are partly supported by the layer of lubricant which is retained in place by adhesion and capillary action. The sustaining power and endurance of a lubricant is determined by actual wear upon a good journal; the economy of its use depending upon its capillary qualities and wearing power. The liability of a journal to heat varies directly as the intensity of pressure and as the amount of work done. The evolution of heat has a serious ill effect in several ways; it reduces the viscosity and density or gravity of the lubricant, thus rendering it more liable to exude from between the rubbing surfaces; it causes serious injury to the surfaces in contact, cracking, distorting, and abraiding them, thus increasing the friction and finally destroying the journals and bearings; and consequent destruction of trains and loss of lives sometimes results from the use of improper lubricants, or neglected or badly proportioned bearings.

Since lubrication has for its objects both the reduction of friction and the prevention of excessive development of heat, the value of a lubricant depends on its efficiency in reducing friction, its durability under wear, its freedom from liability to "gum," its freedom from acid and grit, and its permanence of composition and its physical condition when subjected to changes of temperature. It is of great importance to remember that the higher the temperature the less is the lubricating power of any lubricant; and consequently if we have an efficient lubricant under normal conditions, it should not be assumed that a hot bearing may be cooled by increasing the quantity of lubricant on it; but the cause of the bearing heating should be removed, and time and money saved.

It is needless for the writer to attempt any discussion or comparison of the various lubricants and their characteristics, which some chemists consider of so great importance in the selection of a lubricant. Suffice it to say, that it has long since been an acknowledged fact that vegetable oil and animal fats are inferior to properly refined petroleum oil for machinery lubrication. Nearly all vegetable and animal oils are compounds of glycerine with fatty acids, and in this respect essentially differ from the mineral oils. When kept for a long period decompsition takes place, acid is set free

and the oil becomes rancid. This rancid oil will attack and injure machinery.

Regarding viscosity, gravity and the flash and burning temperature, assumed by some to be of so much value in determining the quality of lubricating oils, Iltyd I. Redwood in his "Lubricants, Oils and Greases," says:

"The tests that usually influence the choice or purchase of lubricating oils are the specific gravity and viscosity; but in reality these tests count for little, for the reason that but a small idea of the lubricating quality of an oil can be gained from either of the tests separately, and not very much even when taken conjointly, except in extreme cases; as, for instance, we know that a very thin light oil is useless for steam cylinder and heavy journal lubrication, and that a thick heavy oil is equally useless for light high-speed spindles."

Dr. J. Lewkowitsch, writes in his "Chemical Technology and Analysis of Oils, Fats and Waxes":

"Specific Gravity: It may be pointed out that this characteristic affords little or no information as regards the lubricating power of an oil.

"The specific gravity number is, however, an aid in selecting an oil for a particular class of machinery.

"The viscosity number does not furnish an absolute means of determining the lubricating value of an oil either, although it enables one to draw certain conclusions. Thus, if the viscosity is low, the film of oil which keeps the bearings of rapidly moving machinery apart is not sufficiently developed to keep the metal surfaces asunder, and therefore the friction between them is not sufficiently diminished. Again, if the viscosity of an oil is high, the resistance of the film is so great that heating occurs and the bearings become warm, or even hot, the heat so generated being proportional to the internal friction of the oil, or, in other words to its viscosity. *That oil will prove the best which under given conditions of speed, pressure and temperature has the lowest permissible viscosity.*"

It may be seen from the foregoing that some of the very best authorities on the subject attach but little importance to the gravity and viscosity in determining the actual quality of a lubricating oil.

Many consumers of large quantities of lubricating oils, particularly large railway systems, are provided with laboratory facilities, both chemical and physical, and it not infrequently happens that those in charge of these laboratories feel that the department is not entirely fulfilling its purpose if it does not exercise a certain supervision over the purchase of lubricating oils; making very rigid requirements for the flash, burning, viscosity and gravity tests. Assuming when the oils meet these requirements that they have fine lubricating qualities, when, as a matter of fact, oils having much better lubricating qualities may be barred by the very requirements intended to serve as a means for getting the best; the requirements thus defeating the very purpose they were intended to serve.

Professor Thurston, than whom there is no higher authority on the subject of lubrication and friction, states in his work entitled "Friction and Lost Work in Machinery":

"The consumer will usually find it economical to use that lubricant which he has found to be the best, with little regard to price, and often finds real economy in using the better material, gaining enough to repay excess in the total cost very many times over."

He also writes further in referring to cost of lubricants:

"Costs involved in purchase of lubricants, and which are determined when an oil is bought, are not simply those of purchase and use of the oil; they are the cost of oil for the given period of time, plus cost of use, plus cost of friction accompanying its use as measured in wasted power and in wear and in expense of accident for the same period. And it has been seen that the cost of a good oil, suitable to the intended use and wisely applied, is probably always least and is often utterly insignificant relatively.

"In one instance reported, the saving in cost of oil on the locomotives of one division of a railway, substituting a more expensive for cheap and inefficient lubricant, was $2,500; but the saving in fuel through reduction of wasted power was over $15,000, a ratio of six to one. Repairs were also reduced, but in amount not reported."

Before taking up in detail one of the most essential features involved in the operation of the modern locomotive, let us take a cursory glance into the history and evolution of this, man's greatest achievement; certainly greatest in its effect upon the race. Of all the wonderful results accomplished by the ingenuity of man during the past century, this combination of mechanism to transmit power has effected the greatest revolution in human affairs. No other factor has exerted the influence in raising the human race to the present high plane of civilization, and in bringing man into such common touch as the locomotive. Let it not be assumed that man recognized this great boon when it was first presented to him, or that he was able to see, even to a limited extent, the great influence this device was destined to have in his advancement. On the contrary, the early promoters of the locomotive met with a stubborn opposition from some of the most powerful sources contemporaneous with its inception.

As late as 1829, twenty-five years after Richard Trevithick had put into practical operation his first locomotive, *The Quarterly Review,* a London publication, said:

"As to those persons who speculate on making railways general throughout the Kingdom, and superseding all the canals, all the wagons, mails, stage coaches, post-chaises, and, in short, every other mode of conveyance by land and water, we deem them and their visionary schemes unworthy of notice. The gross exaggeration of the locomotive steam engine may delude for a time, but must end in the mortification of those concerned. We should as soon expect the people to suffer themselves to be fired off upon one of Congreve's ricochet rockets, as trust themselves at the mercy of such a machine going at such a rate."

However, notwithstanding the evident opposition met with by the promoters and advocates of the device, from the time of Cugnot's first steam-driven "land-carriage," in 1771, and Trevithick's locomotive, of 1804, designed to run on rails, the various designers continued to develop the locomotive until the famous contest at Rainhill, which took place in the year 1829, when Robert Stephenson's locomotive the "Rocket," weighing 8,300 pounds and drawing a total load of seventeen tons at a speed averaging a little over fourteen miles per hour, demonstrated to the world not only the practicability of the steam locomotive, but also something of the immense advantage to be obtained by man from its use. In 1832 the "John Bull," the first locomotive built on the lines of the present locomotive, weighed but 22,425 pounds, while that of the great modern machine may be more than 270,000 pounds, with as much as 55,000 pounds on a single driving axle. This wonderful advance in the evolution of the locomotive indicates an almost incredible advance in railroad transportation, and accounts for the fact that a bushel of wheat can be brought overland at the present time from Chicago to New York City, a distance of 900 miles, for less than the charge for delivering a handbag from the Pennsylvania railway passenger terminal to the Waldorf Hotel, a matter of a few blocks.

When it is considered that the locomotive, and all it has accomplished in the interest of man, would not have been possible but for the principle of lubrication, the importance of a knowledge of this subject becomes at once apparent. Lubrication has been, and is, just as essential in making

the locomotive possible as that great source of power, heat energy, or the water which affords a medium for its conversion into an active force. Without lubrication the locomotive would be impossible, and even with it a considerable portion of the power developed by the locomotive is exerted to overcome the resistance in its moving parts due to friction.

While the information obtainable on the subject is rather meager, we know that the lubricants used and the means of applying them to the primitive locomotive were in keeping with the crude design of all the parts; and inasmuch as we find that the modern locomotive with its nicely designed parts and using the very best lubricants, applied by modern methods, loses through friction over ten per cent of the maximum power developed; and as we know this quantity or proportion of waste energy is considerably affected by the quality of the lubricant used, it is reasonable to suppose that the success of the early locomotive was in no small measure delayed by faulty and inefficient lubrication.

Previous to 1869 the lubricants used and the manner of applying them to the locomotive differed very little from the lubricants and methods employed on other classes of machinery. Taking up first, as being the most important, the lubrication of the main valve and cylinders we find tallow to be the material that was principally used for this purpose. This material served to separate the rubbing surfaces, but for preventing wear of the parts it was probably more harmful than helpful, on account of the erosive effect of the free acid it usually contained. An open-top cup located on the steam chest was the original type of lubricator until 1864, when the cups were located in the cab and connected to the same point on the steam chests by sloping pipes; thus obviating the necessity for either the engineer or fireman going to the front end of the engine, at such times when the throttle might be closed, to oil the valves and cylinders. Along about 1870 the necessity for an even flow of oil to valves and cylinders of locomotives was met by the introduction of the steam chest oiler, that could be filled and adjusted to feed a constant and controllable flow of oil. This device was the forerunner of the modern updrop-sight feed hydrostatic lubricator, which has been developed to meet the real and imagined demands, until it has so many feeds that the ordinary engineer finds it necessary to devote almost as much thought to it as to the modern air brake equipment.

Almost coincident with the appearance of an adequate device for properly conveying the lubricant to the valves and cylinders, the great need of a proper lubricant for this purpose was met by the founders of the Galena-Signal Oil Company, with a compounded mineral oil that not only filled the need at that time for a perfect valve and cylinder lubricant, which was entirely free from acid and "gummy" properties, (the characteristics so objectionable in the lubricant then in use), but also throughout the interval from its introduction to the present day, this oil has been able to fulfill all the requirements for perfect valve and cylinder lubrication, notwithstanding the transition from low to medium, then to high steam pressure; and finally to high temperature superheated steam. And in view of the very satisfactory service this oil is rendering on locomotives using steam superheated almost to the point of incandescence, it is safe to say that so long as its present quality is maintained, it will continue to meet all demands placed upon it.

The present hydrostatic lubricator with its disk sight glasses and attachments for stopping the feed without disturbing the adjustment of the feed valves, and automatic drain valve for preventing loss of oil when draining lubricator, is a tremendous advance in the interest of safety and economy over the tallow cup of forty years ago. But it is neither fool proof nor perfect; it requires intelligent handling for effective service, and for it to give the most effective service the locomotive must also have intelligent handling. The lubricator should be so located that the engineer may have an unobstructed view, not only of, but through the sight feed glasses; and in all cases it must be located so that the oil pipes have a constant downward course; as an upward turn in the pipe will pocket the oil and result in an intermittent feed to the valve and cylinder, and consequent imperfect lubrication.

The writer was recently called to investigate a complaint of imperfect valve lubrication on a locomotive, and found the lubricator located on the engineer's side of the boiler eight or ten inches below the top; the lubricator pipe to the left steam chest was trained up over the boiler and had to slope upward at least ten or twelve inches above the point of connection at the lubricator.

The lubricator pipes should enter the steam cavity, or steam pipe, well above the steam chest and not at the top of the steam chest, as did the old fashioned tallow cups, for the reason that it has been pretty well established that the most effective valve and cylinder lubrication is accomplished by saturating the steam with the lubricant before it comes into contact with the parts to be lubricated, rather than depending upon the parts being smeared with the lubricant. In view of this it is hard to understand why the practice of entering the pipes at the top of the steam chest is continued, unless it be due to the general tendency to pursue old methods. Much advantage in producing an atomized condition of the oil on its coming in contact with the steam, has been secured by extending the lubricator pipe well into the steam cavity or pipe, and producing a perforated spoon-like effect of the extension by cutting away the top half of the pipe and drilling holes or cutting slots in the bottom half.

Admitting the theory of saturating the steam with the lubricant to be true, it is evident that that oil which can be most readily taken up by the steam without having its lubricating qualities impaired, is the most effective lubricant; granting, of course, that service has proved it to be an effective lubricant. Thus, assuming a number of cylinder oils of uniform lubricating quality, the thinnest or the oil of least viscosity at a medium temperature would mingle most readily with the steam, and according to the theory of saturating the steam with the lubricant, afford the most effective lubrication; provided the rise in its temperature, due to contact with the steam, did not lower its viscosity sufficient to impair its effectiveness. Sometime prior to 1897 the testing department of the C., M. & St. Paul Ry., made viscosity tests of fifteen different cylinder oils with the result that the "Galena Perfection Valve Oil" was shown to be the thinnest at 250 degs. F., and least affected when the temperature was raised to 350 degs. F. The viscosity of Galena Perfection being reduced only 18 per cent by the increase of 100 degs. temperature, while the average for the other fourteen oils showed a reduction of 43 per cent for the same increase in temperature.

Going a little further with the same reasoning, it is the writer's experience that the most effective lubrication is accomplished in the cylinders of engines using saturated steam, when the oil comes in contact with the steam in the form of an emulsion—the oil in this condition being highly impregnated with water. This emulsion probably results from the oil forming a coating in the bottom of the lubricator pipe and the condensed steam picking it up in small particles during its downward passage to the steam chest. When this emulsion or mixture of oil and water comes in contact with the steam it immediately flashes into steam, owing to its large content of water. The steam in this way becomes saturated or filled with small particles of oil, which congeal and adhere to the surrounding walls and all enclosed surfaces. This separation of the oil into small particles and consequent distribution by the steam, is not so well ac-

complished when the oil feeds into the steam in a condition unmixed with water, as the vaporizing temperature of the oil is considerably higher than the temperature of steam at 200 or even 225 lbs. pressure. Hence, this additional argument in favor of an oil that is not too heavy at a medium temperature, as the thin oil will mix more readily with the condensed steam.

This line of argument does not apply to engines using superheated steam so much as the heat of high temperature. Superheated steam is usually sufficient to separate the oil into particles small enough to be carried by the steam without the presence of water.

In connection with the thought just advanced it is proper to bear in mind that with the use of the hydrostatic lubricator, the oil is not forced into the steam chest, but is entirely dependent upon the force of gravity to carry it there. This dependence upon gravity for perfect operation, and the fact that the gravitative force only acts upon the oil when the steam pressure is uniform throughout the entire length of the lubricator pipe, is probably the greatest imperfection of the hydrostatic lubricator; but its reliability in other respects and its ease of maintenance so preponderates this fault that it is commended as the most acceptable device for the purpose. As practically every hand-book published for the benefit of the locomotive engineer, describes in detail the various types of hydrostatic lubricators and the proper method of applying and operating them, the writer does not deem it necessary to devote space to features that have been fully covered by more able writers. The very best possible information regarding the operation of the lubricator and the efficient and economical use of valve oil, may be found on page 17, of the pamphlet entitled, "Lubrication," published and distributed by the Galena-Signal Oil Company, Franklin, Pa.

The engineer of experience has learned that it is necessary when working his engine under certain conditions, with full throttle, to occasionally ease up on the throttle to permit the steam pressure in the lubricator pipes to equalize, otherwise the pressure becomes greatest at the steam chest end of the pipes, and the material in the pipes ceases to flow downward, thus interfering with proper lubrication. When the engineer is unacquainted with the existence of this condition, he often erroneously assumes that the lubricator is not feeding enough oil when his engine begins to indicate improper lubrication.

With the more general application of high temperature superheaters to locomotives, many were concerned to know how the valves and cylinders of the locomotive using high temperature superheated steam were to be lubricated, and whether the oil would stand the high temperature and still retain its lubricating properties. Because of the use of improper material in the cylinders and packing, and the lack of experience in handling the superheat locomotives, much trouble was at first experienced in the operation and maintenance of some of these locomotives, and it was very promptly assumed by some that the fault lay in the lubricant. The manufacturers of the lubricant, after careful investigation, determined that the lubricant was able to meet this new tax upon it without being appreciably affected as to its value, and were very shortly able to convince the doubtful of the correctness of their conclusions.

Since the substitution of materials more able to resist wear and tear at high temperature, and a better knowledge resulting from experience, in the proper handling of the superheat locomotive, the troubles of maintenance and operation have practically disappeared and it has been found that this type of locomotive can be just as effectively and economically lubricated as the non-superheat locomotive.

The important thing to remember in the operation of the locomotive using superheated steam is, that the lubricant does not flash or burn in an atmosphere of steam, even though it be a thousand deg. F. Therefore, if cars be exercised to maintain an atmosphere of steam in the steam chests and cylinders, there will be no carbonization of a proper lubricant. Those railway officers having had the longest and most extensive experience in operating the superheat locomotives, require these engines to be equipped with some form of auxiliary or drifting throttle, to be opened when the main throttle is closed while the engine is drifting.

On the general introduction of the Mallet type and the locomotive using steam superheated to a high temperature, the lubricator with a multiplicity of feeds found much favor with those who were apprehensive regarding the successful lubrication of these locomotives. It was, and is still assumed by some, that the introduction of oil directly into the cylinders of these locomotives would more certainly insure proper lubrication of the cylinders. This opinion brought into use the lubricator with a sufficient number of feeds to meet this idea.

Experience has taught the unprejudiced that the direct cylinder feed is not only unnecessary, but that better results are actually obtained without it. Much of the accumulation in the cylinders and deposit on the cylinder walls of these engines is undoubtedly due to too much oil, and this has been found to be the case mostly with engines equipped with the lubricator pipes connected direct to the cylinders.

If the theory of effective valve and cylinder lubrication by saturating the live steam with the lubricant be true, then it is true that the lubricator pipes leading directly to the cylinders are not necessary; because ample lubrication is secured from the particles of oil contained in the steam, which must come in contact with the cylinder walls after leaving the steam chest. The hydrostatic lubricator must inevitably maintain a more continuous and uniform feed of oil to the cylinders on locomotives using superheated steam than on those using saturated steam; for the reason that the steam in being forced through the contorted passages of the superheater suffers a loss in pressure before reaching the steam chest, consequently the steam pressure in the lubricator pipe, at the steam chest end of the pipe, never exceeds or even equals the pressure at the lubricator end.

It should be borne in mind that the only force behind the steam flowing through the superheater to the steam chest is the boiler pressure, and that notwithstanding the superheating, the steam in overcoming the friction in the superheater pipes must lose in pressure before reaching the steam chest.

Since the time when mineral oil was recognized as superior to tallow for the lubrication of valves and cylinders, the adaptability of Galena Perfection valve oil for this purpose, and the knowledge obtained from the experience of its use, has resulted in a most remarkable economy in the lubrication of these parts. Notwithstanding that the surface to be lubricated has practically doubled during this period, the miles run per pint has in most cases been more than doubled.

It is only fair to say that these economical results have been greatly influenced by the Galena Company, first in furnishing a lubricant capable of this economical use, and second in using every possible effort to educate the user up to the possibilities of the oil. And, although this educational course now covers a period of more than thirty years, it is far from being completed. This latter statement is confirmed by the examination of a number of performance statements, from which may be selected the statements of two roads operating practically the same class of power, under practically the same conditions, and finding one of the roads making an average for all locomotives operated of nearly ninety miles per pint of valve oil, and the other less than fifty. And contrary to the doubter, who tells us that a pint of valve oil saved is a ton of coal burned, we find the road making the most mileage for valve oil, also making the greatest number of miles per ton of coal, with the lowest cost per mile for engine repairs. The figures em-

bodying this information on the statements, covering the quarter ending Sept. 30, 1912, of two southern roads having comparable conditions, show for the one, 86 miles per pint of valve oil, 15 miles per ton of coal, and 10.93 cents per locomotive mile for repairs. For the other, 50 miles per pint of valve oil, 9 miles per ton of coal, and 14.58 cents per locomotive mile for repairs.

The advancement in the lubrication of the external parts of the locomotive has probably not been so great as with valves and cylinders, yet a marked improvement has been effected, both in the interest of efficiency and economy, by the substitution of mineral for vegetable and animal oils for this purpose.

The introduction of mineral oil for locomotive lubrication can best be told by quoting from the 1909 report of the Master Mechanics' committee on locomotive lubrication. On page 269, 1909, Proceedings American Railway Master Mechanics' Association, we find the following:

"The mineral oils or petroleums were placed on the market in the years soon following and on account of their cheapness and superiority as a lubricant, their use became general. The natural West Virginia oil, with its notable characteristics * * * immediately found favor and was considered superior to sprem. The production of West Virginia oil was limited, and as the demands rapidly increased, the supply was soon exhausted. Mineral oils of varying qualities, good, indifferent and bad, competed for the lubricating business, and as uniformity was desirable, the old adage of 'Necessity being the mother of invention' was exemplified by a manufacturing concern in 1869 (Galena Oil Company) introducing for railroad service an oil for external lubrication, combining the excellent qualities of nature's best lubricating product with other ingredients, producing an article which met all of the requirements of the day; * * * a gravity permitting of ready flow, and the sustaining power for support of the ever increasing loads upon the bearing surfaces. This lubricant has stood the test of service from the date of its introduction, and is now used on the majority of the railroads of this country, as well as on many of the English and continental lines of Europe."

(The company referred to is obviously the Galena).

The rapid development of the locomotive into units of very heavy power, occasioned by the constantly increasing demands of transportation, have gradually produced such radical changes in the manner of operation and maintenance, until lubricating conditions seemed to demand the use of grease on crank pins; and a little later the same lubricant began to find favor when applied to driving journals.

Although the Galena Company is supplying greases for these purposes, they have, like all of the other lubricants supplied by this company, the greatest lubricating qualities that can be contained in a lubricant of this character. It can not be said that this type of lubricant affords the same effective lubrication in some respects as a good oil; and yet, owing to design of the parts made necessary by the increase in size of power, and the severe service the power is subjected to, the use of grease on crank pins has met with practically unanimous favor, and is coming to be used more and more on driving journals. It has been said of grease, as compared with good lubricating oil, that the essential difference is due to the difference in their molecular construction, the molecules of oil being of a spherical shape which revolve on and against each other, while in a grease they are irregular in shape with no tendency to free movement.

This description of the difference in grease and oil is no doubt entirely true when applied to the ordinary greases found on the market, which are usually compounds of lime, water and refuse fats; but the greases furnished by the Galena Company are of an altogether different type. In the manufacture of Galena crank pin grease and driving box compound, the highest quality of lubricating oil is used, and while this grease is made sufficiently plastic to remain in place, and in this way meet the required conditions, it contains all the friction reducing qualities of a high grade lubricating oil when the rise in the temperature of the bearing causes it to flow.

The popular argument in favor of the use of grease on driving journals is that the bearings require less care and attention than when lubricated with oil. The influence of this argument has been rather far-reaching in its effect upon the conditions surrounding the lubrication and maintenance of the most important bearings on the locomotive, with the result that so little care is coming to be used in the proper preparation and maintenance of main journals and bearings that it is to be feared the day may come when the mechanical department will have to recognize that power conditions with grease lubrication are more of a problem than with oil, and the executive officers of roads will endeavor to find the cause of the increased fuel consumption.

The annual oil bill of a large and important railroad is something of an item, and the effective lubrication of the locomotive has a vital relation to successful transportation, but the cost of fuel and locomotive maintenance are subjects which in the present struggle for profitable operation can not very well be ignored. Fuel consumption for locomotives of this country is estimated to exceed $200,000,000 annually. If the loss of energy of the locomotive, under the best conditions be ten per cent, and the conditions are such as to increase this loss five per cent., ten million dollars are added annually to the cost of fuel, from which no revenue is being derived.

Whether lubricated with grease or oil, the driving journals are of sufficient importance in the successful operation of the locomotive to give them such attention that will insure their running at the lowest possible temperature, and with the least possible frictional resistance. Locomotives in service without brasses in the main driving boxes have come under the personal observation of the writer. The main driving axles and boxes of these locomotives had to be entirely renewed at a cost ten times greater than if the brasses had been renewed at the proper time.

To get the best possible results from the use of grease in driving boxes, the brasses should be made of good bearing metal, homogeneous and free from all imperfections incident to poor foundry work; they should be bored to proper diameter and given a reasonably good fit, using the same care in all respects as for oil lubricated bearings. The perforated screen of the grease cellar must be made to exactly conform to the diameter and have a full bearing against the journal over its entire surface; otherwise the grease does not feed properly and becomes carbonized, resulting in a hot box. The grease cake should be machine pressed to fit the cellar and not allowed to get too thin before it is renewed.

Successful lubrication of driving journals with oil may be insured by using good bearing metal in the brasses properly fitting them to properly turned and finished journals, and having the oil packing in the cellars maintained at all times in a uniformly good condition against the journals, by frequent inspections.

Driving journal lubrication is too important a feature in locomotive operation to relegate to the ignorant and irresponsible.

The practice of blowing off locomotive boilers in the pit directly under the driving journals has a detrimental effect upon the driving journal packing and is particularly objectionable when the cellars are packed with grease, as the condensed steam has a very deteriorating effect upon the grease.

Great trouble is sometimes experienced with locomotive driving journals heating due to an arrangement of spring

rigging with spring hangers so located as to throw an eccentric load on driving box. Spring hangers should always be located so the load is applied directly over the center of the box, and the designer should bear in mind that successful lubrication is one of the essential features in the operation of the machine.

Running locomotives at high speed, that have been designed to pull heavy loads at slow speed, is one of the most common causes of the heating of locomotive journals. A locomotive with driving wheels 54 ins. diameter, journals 10 ins. diameter, and a 30-in. piston stroke, running forty-five miles an hour, has a piston speed of 1,400 ft. per minute, and the speed of the surface of the driving journal is 12 ft. per second; the speed of both the piston and driving journals being twice what it should be.

The lubrication of the other parts of the locomotive has undergone no great change, except in the character of the lubricant and the economical use of it.

The adoption of types of valve gear other than the Stephenson link motion, the rubbing parts of which are more accessible and less liable to heat, has assisted much toward more effective and economical lubrication of these parts.

Guide bars are found to be more effectively and economically lubricated by locating a packing cup midway of the length on top of the bottom crosshead shoe, and one adjustable feed oil cup midway of the length on top of the top guide bar.

The improvements in the parts of the locomotive; improved oil houses equipped with adequate storage tanks and self-measuring devices; improved methods of saturating the waste packing, and removing the surplus oil, in room kept at proper temperature; the reclamation and re-use of grease; the reclamation and renovation of old waste packing by putting it through a hot oil bath; the proper preparation of grease into forms for driving journal lubrication and into candles and disks for crank pin lubrication; and above all, the daily attention given the subject by railway officers and subordinates, combined with the greatest of all essentials, in the economical use of anything, proper accounting and comparative statements; have all been important factors in bringing about an economy in locomotive lubrication that has not only awakened the wonder of all acquainted with it, but has aroused such an interest in the minds of railroad officers that they have applied the same methods for economy to other departments, with the result that it is impossible to estimate the total saving that has resulted directly and indirectly from these methods.

The factors just enumerated cannot possibly lose in importance by mentioning that back of this whole movement has stood the Galena-Signal Oil Company, with lubricating material of a quality, the limits of which (even after an educational course of the most extensive kind), are not yet fully known. The educational campaign on the part of the oil company resulting in so much benefit to the railroads, was in a great measure brought about by the contract system adopted by General Charles Miller, then and until recently president, and now chairman of the board, and still actively engaged in the company's business, as the best means of demonstrating to the railroad world that a good lubricant is in the end the most economical, even though the initial cost be some greater. Time has proven the contract system as developed by the Galena Company, and applied to the department of lubrication, to embody all of the principles of scientific management, and General Miller has been aptly referred to as the pioneer Efficiency Engineer.

Notwithstanding some opinions to the contrary, the economical lubrication of the locomotive inevitably means efficient lubrication; for the reason that a more than sufficient supply of oil not only encourages a wasteful and careless application, but also fosters a thoughtless and irresponsible attitude toward locomotive operation and maintenance; while a supply which has been intelligently determined as sufficient, tends toward careful use of lubricant and careful operation and maintenance. Even at this late day, when we know that after all, the modern term "Scientific Management" is only a term for finding the best and making it the standard, and although in almost every department of human endeavor, limitations, recognized as standard are applied, there are those who still hesitate to limit the supply of oil to meet certain conditions, even when the quantity to meet said conditions has been well established.

There is no good reason why a number of men operating the same machine, under the same conditions, should not be able to lubricate the said machine, doing uniform quantities of work, with uniform quantities of lubricant. Any other arrangement simply encourages inefficiency on the part of some of the operators.

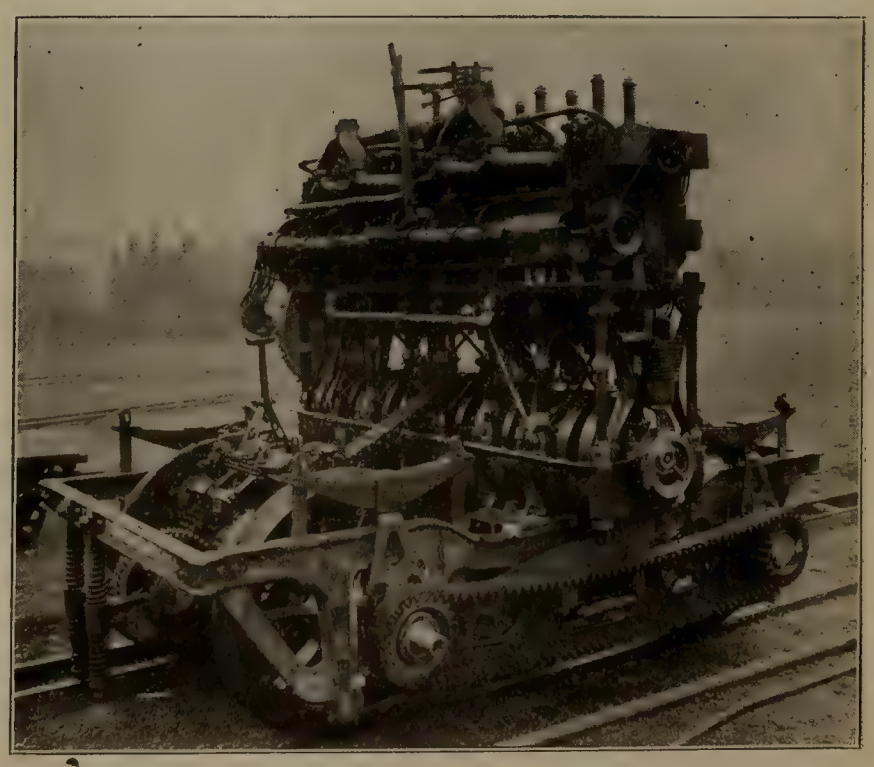
The great difference existing between the results obtained on different railroads toward economical and efficient locomotive lubrication, is the strongest possible argument that the work of education has not been completed, but really just begun.

The last performance statements of two roads operating practically the same power under about the same conditions, shows for one a cost of $1.55 per 1,000 locomotive miles for lubrication, and 15 miles per ton of coal; while the statement for the other road shows $2.60 per 1,000 locomotive miles for lubrication and 9 miles per ton of coal. An additional illustration of the possibilities for further education on this subject is a road operating in the writer's territory, which showed the following:

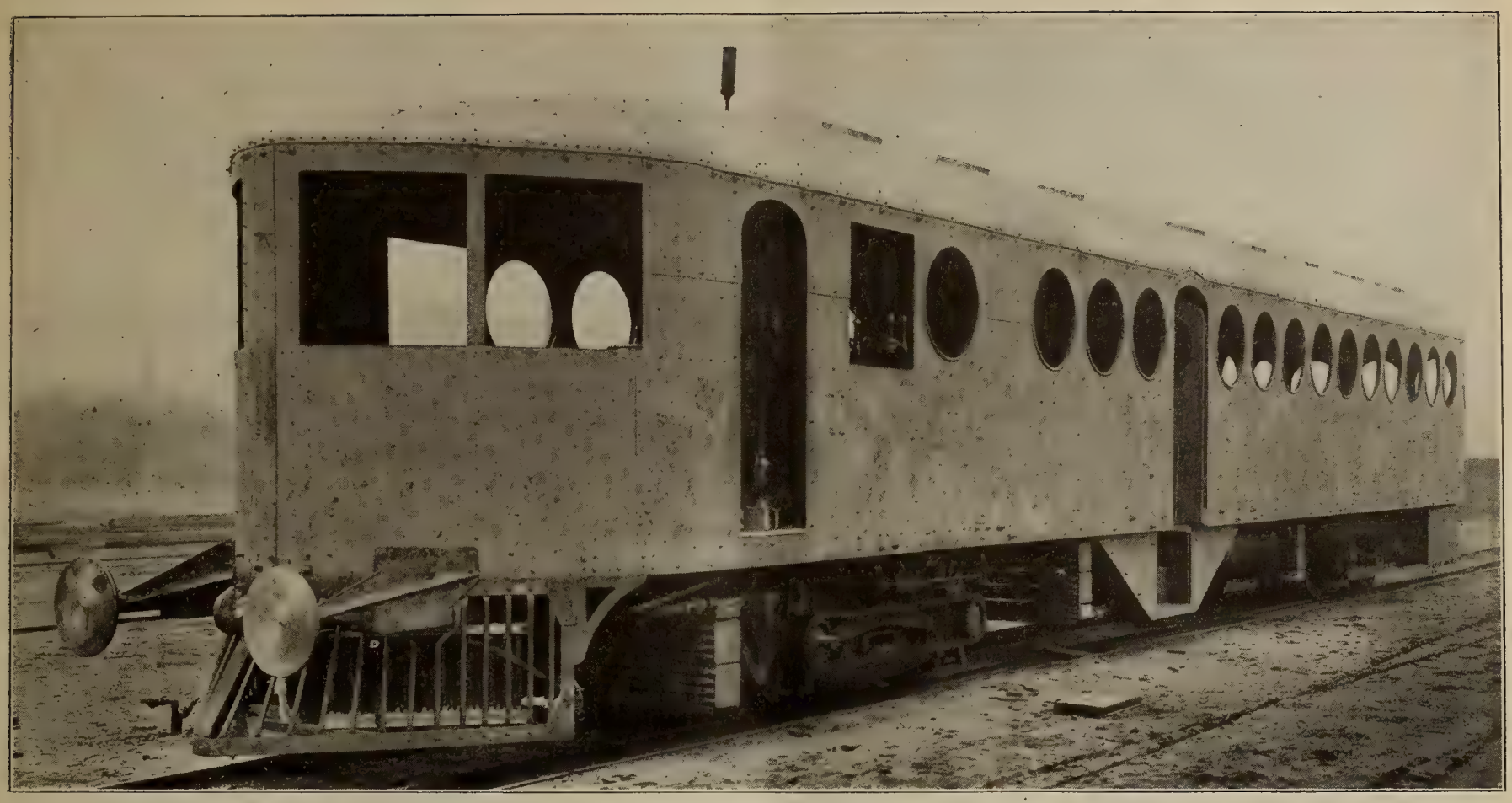
For the Year Ending	Miles per Pint All Lubricants	Cost of Repairs Per Mile	Miles Run per Ton of Coal
April 30, 1911	13.5	9.43c	12.1
April 30, 1912	19.7	9.01c	12.3

NARROW GAUGE MOTOR CARS.

The McKeen Motor Car Company, Omaha, Neb., recently completed and shipped five 200 h. p. all-steel, 55-ft. gasoline motor cars from their works to the Queensland Government Railways in Australia. These are to run on a 3 ft. 6 in. gauge and are the first narrow-gauge motor cars ever turned out. Complete dismantling of the cars followed their construction, the cars being shipped knocked down to Australia. The manufacturers, however, will send an expert to superintend the re-erection of the cars in the railway company's shops at Ipswitch. This gasoline rolling stock con-



Power Plant of McKeen Car for Australian Railways.



McKeen Car for Queensland Railways Before Being "Knocked Down."

forms to the McKeen standard design and construction with the exception of some special features which are necessary to meet the requirements of the Queensland Railways, as for instance:

The position of the operating levers is reversed for left side control.

Side type of the buffing gear with draw hook, screw couplings, displace the M. C. B. couplers.

The depressed center entrance is constructed so as to provide accommodations for handling passengers at elevated as well as roadside platforms with equal facility.

The motor truck wheel base being limited to 6 feet, in combination with the specially designed front bolsters (body and truck), makes the car suitable for operation on the sharpest curves encountered over city railways.

Each motor truck side frame is one integral steel casting, bolted and wedged against the skirk or bed plate, the side frames in combination making an unusually light as well as remarkably strong and durable entire cast steel truck frame.

Artificial illumination is provided by the Stone electric system. The seating capacity of each car is 69 passengers, of which 55 are accommodated in the main compartment and 14 in the smoker.

Notable features and measurements of the cars and power units are as follows:

Power units, trucks:—

Wheels.....4, cast steel center, steel tired, dia. 36 ins.
Journals 6x10
Wheelbase ..... 6 ft.
Side frames and bolster.....Cast steel

Gasoline engines:—

Six cylinders .....10-in. bore, 12-in. stroke, 200 h. p.
Air starting and reversible.

Transmission:—

Morse ..... Silent chain drive
Two speeds .....Direct and geared
Multiple disc clutch.

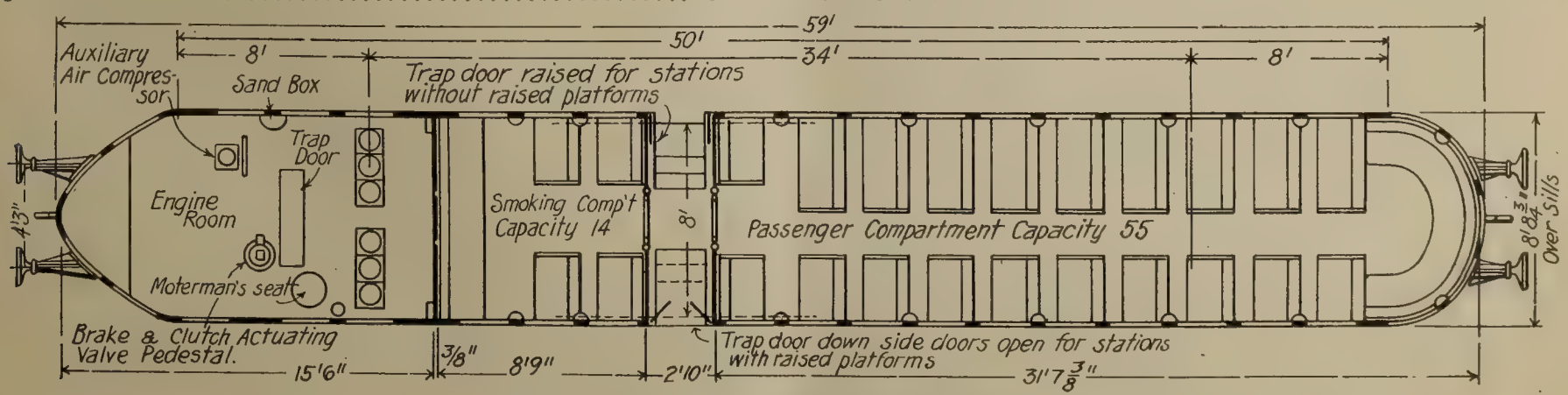
Car bodies:—

Length over end sills .....59 ft.
Length over buffers .....62 ft. 5¼ ins.
Width over sheathing .....8 ft. 9 ins.
Height, rail to roof .....11 ft. 8½ ins.
Length passenger compartment .....31 ft. 7⅜ ins.
Length smoking compartment .....8 ft. 9 ins.
Height inside floor to ceiling .....7 ft. 8⅛ ins.
Distance between center plates ..... 34 ft.
Total wheel base .....40 ft.

Weights:—

Total ..... 60,000 pounds
Front drivers .....17,900 pounds
Rear drivers .....17,500 pounds
Rear trucks ..... 2,460 pounds

The two 70-ft. McKeen motor cars shipped to the Victorian Railways a year ago are reported to be giving perfect satisfaction.



Plan of McKeen Car for Queensland Railways.

ELECTRIFICATION OF THE MELBOURNE SUBURBAN, VICTORIAN RAILWAYS.

Probably the most notable railway electrification project at the present time is that about to be undertaken in connection with the suburban steam railways of Melbourne, Australia. The advisability of the step has been under consideration for a number of years, and in 1908 Mr. Charles H. Merz of the firm of Messrs. Merz & McLellan, Victoria Street, Westminster, London, presented a comprehensive report on the subject to the Victorian Railway Commission. In this report Mr. Merz, acting as consulting engineer on the scheme, went very fully into the whole question of the substitution of electric traction on steam railways.

In a later report, embodying a comparative analysis of the merits of both single phase alternating current and high voltage direct current systems, based on the tenders submitted, Mr. Merz points out that the adoption of the high tension direct current system for this application would mean a saving of about $3,500,000, or nearly 30 per cent in the cost of installation over that of the single phase system. Accordingly, in view of this initial saving and a further operating economy, as indicated by Mr. Merz, of about $350,000 per annum, or nearly 28 per cent, he recommended very strongly the adoption of the high tension direct current system for the Melbourne Railways, and the Victorian Government accepted his recommendations.

Melbourne, the capital of the State of Victoria, is situated in the southern part of eastern Australia on the Yazza River, eight miles from its mouth at the head of Port Fhilip. The river is accessible for vessels drawing 22 feet of water, and all larger vessels are easily accommodated at Port Melbourne in Hobson Bay. Along the river are large docks, shipyards, foundries and manufacturing plants representing a number of industries. The city has a population including its suburbs of over half a million, and is the most important municipality and the greatest trade emporium in Australia.

The electrification of the Melbourne Suburban Railways is of exceptional interest because it will be one of the largest projects of its kind in the world, involving heavy rolling stock equipment with overhead collectors. The magnitude of the undertaking from the standpoint of equipment and service may be compared with that on the third rail electrified section of the New York Central Railroad out of New York City, and ranks with the Oakland, Alameda & Berkeley electrification of the Southern Pacific Railroad at San Francisco.

Naturally, the great size and tremendous importance of the project attracted world-wide competition, and among the leading manufacturers of electrical apparatus submitting tenders are included the Allgemeine Electricitaets Gesellschaft, Berlin; British Westinghouse Co., Manchester; Dick Kerr & Co., Ltd., London; Ferranti, Ltd., Hollinwood; Siemens Bros. Dynamo Works, Ltd., London; General Electric Company, of New York, and others. After an exhaustive study and consideration of the relative merits of the several propositions, Mr. Merz approved in his report the recommendations of the General Electric Company of New York as to choice of system and economical features of operation, and the Victorian Government awarded this company the contract for the rolling stock apparatus equipment, comprising 400 moter car equipments, consisting of four motors each; 800 control equipments, 400 of which are for trailer cars, and 400 air compressor equipments. This is the largest single order ever placed for electric railway apparatus.

The mileage of the suburban lines included in the scheme is made up of 150 route-miles, or 289 track-miles of running roads, and 24 miles of sidings. The potential selected for this direct current system is 1,500 volts. Power will be supplied from a central station at Yarraville, a suburb of Melbourne, in the form of three phase alternating current at 25 cycles per second and will be transmitted at 20,000 volts to twelve substations at various points on the system, where it will be converted into the operating direct current of 1,500 volts. the high tension transmission is by underground cables from the power house to the important substations in the central area, and by overhead wires erected on the same structures which carry the railway track conductors, to the outlying substations. Overhead conductors will be used throughout the system for supplying current to the trains, which will be equipped with roller pantograph collectors. The complete equipment of the railways involves the expenditure of $12,000,000 in round numbers, and Mr. Merz figures the saving of electric operation will amount to about $600,000 in 1915 over the former steam operated lines.

Normal trains, weighing about 180 tons, will consist of two motor coaches and two trailer coaches. The tracks are 5-ft., 3-in. gauge. The suburban traffic amounted to 70,000,000 passengers in 1908; the figure the past year exceeds 90,000,000; and in 1917, when it is expected that the conversion to electric operation will be entirely completed, it is estimated that the suburban lines will carry 150,000,000 passengers per annum. The present plans are accordingly based on provision for this probable increase in the passenger traffic; but all parts of the electrification scheme are arranged so as to be capable of extension from time to time, as the traffic subsequently grows. Handling heavy traffic during the rush hours of morning and evening will be provided for by increasing the length of trains, although for this initial service it is the intention to have the maximum train consist of six coaches.

The motors, numbering 1,600 in all, which will be installed in the 400 motor coaches, will be of new design throughout and will embody the most modern developments that the General Electric Company has introduced in railway motor construction. They will be known as Type GE-237, will have inherent ventilation and be provided with commutating poles. They will be rated 140 horsepower at 725 volts and will be operated two in series on 1,500 volts.

The method of self-ventilation which will be incorporated in the design of these motors will assure exceptionally effective and uniform cooling. This will be accomplished by a broad-bladed centrifugal fan cast integral with the pinion end armature core head. Fresh air is drawn into the interior through a screened opening on the upper side of the motor frame at the pinion end. This is circulated over the armature and field coils, under and through the commutator, through longitudinal holes in the armature core, and thence exhausted to the exterior through openings in the pinion end bearing head.

Scientifically correct in principle, this method of ventilation has been demonstrated through service tests to be a successful manner of securing evenly distributed cooling; for without complication it circulates effectively a large volume of cool air throughout the motor and keeps all parts at a uniform temperature, eliminating the possibility of "hot spots." The service capacity of the motor, due to its ventilation, is rendered much greater than that of an ordinary motor of the same nominal rating. At the same time, the weight per horsepower is greatly reduced without sacrificing mechanical strength, durability or electrical efficiency.

The service on the lines calls for both local and express schedules. The motors will therefore be arranged for tap field control, which will allow a free running speed of 52 miles per hour over level track for the suburban cars on express runs. This method of auxiliary control was introduced by the General Electric Company a number of years ago, but due to commutating limitations of earlier motors it was eventually abandoned. Its successful application to commutating pole motors is therefore modern.

The principal advantages to be derived from tap field con-

trol are increased operating efficiency, continuous saving of power, economy effected through decrease in the weight of the equipment and an increase in the service capacity. The practical effect of tapping the field is to eliminate one resistance step and to secure the desired accelerating effort throughout from start to full speed with a lower current input.

The 800 control equipments for both motor and trailer cars will be the well-known Sprague-General Electric Type M relay-automatic control and do not require description. They provide for multiple unit operation and control of the train from the platforms of any motor or trailer car. Type M control has been in operation on heavy traction work for many years, notably on the subway and elevated divisions in New York and other large cities, and has demonstrated its simplicity, low maintenance and reliability.

It is interesting to note that two of the principal factors that apparently influenced Mr. Merz and the commissioners to decide in favor of the high tension direct current system, rather than the single phase alternating current system, were the lower maintenance of the rolling stock equipment and the saving in energy consumption. They found that the greater number and complexity of the electrical parts carried on the coaches in the case of the single phase equipments not only causes these equipments to be initially more expensive, but also renders them more costly to maintain; and when routine inspection is taken into account, and also the fact that repairs are necessary subject to the exigencies of traffic requirements, the maintenance of single phase equipments would exceed that of direct current equipments in a slightly higher proportion than that governing their respective first costs.

The GE-237 direct current motor selected for these equipments is designed especially to obtain low energy consumption. This comparison of energy consumption is included in Mr. Merz' report in the number of kilowatt-hours required by a four-coach train making a round trip between Sandringham and Broadmeadows. Based on the several manufacturers' guarantees. Mr. Merz arrives at an economy of 23 per cent in energy consumption in favor of the high tension direct current equipment.

Other points that were brought out as being adverse to the single phase system for this application might be mentioned, as follows: slightly reduced seating capacity of the trains on account of the extra amount of room required by the single phase equipments; the extra wear on the track rails due to the extra dead weight of the single phase motors, and the extra amount of spare plant required in connection with the single phase scheme on account of the greater complexity of the equipments. As we have indicated, Mr. Merz estimated that the annual operating cost of the single phase system would be about $350,000, or nearly 28 per cent more than for the direct current system, and he also came to the conclusion that the latter system would show an increasing advantage over the single phase system as the traffic becomes greater year by year.

Electrification of steam roads both here and abroad has emphasized the fact that the conversion to electrical operation is always accompanied by a faster and more frequent train service, and because of greater convenience, comfort and cleanliness, a general improvement in suburban traveling conditions, while the reduction in working cost and the increased earnings of the line combine to produce larger profits.

The Central New England improvements to engine facilities, of Maybrook, N. Y., consisting of roundhouse, power house, machine shop and coaling plant, are about completed, and the roundhouse is in operation. This company is also constructing a new eastbound classification yard.

BRIEF STORY OF THE DEVELOPMENT OF THE LOCOMOTIVE BOILER.*

By W. F. M. Goss.

The boiler is the locomotive's primary source of power. However efficient the details of its engine, they can be effective in the development of power only when furnished with an ample supply of steam. This must come from the boiler. The boilers of early locomotives were small and inefficient and the problem of improving them as it has presented itself to succeeding generations of designers has been beset with difficulties.

An early form of locomotive boiler was a plain cylindrical structure containing a single flue. At one end of this flue a fire-door was attached, and inside the fire-door, grate bars were arranged. At the other end an elbow was added to connect with a vertical stack. By this arrangement the stack was in front of the boiler, not on it. When the locomotive was operating, the elbow and a considerable portion of the stack were commonly red-hot. An improvement consisted in fitting the boiler with a return flue which brought the stack and fire-door at the same end, and which provided more heating-surface, a longer flameway and lower stack temperatures than were possible with the earlier design. The famous "Puffing Billy," a locomotive which did effective service for many years, was provided with a boiler thus constructed. Obviously, the power developed by such an arrangement could not be great, and the commercial success of the locomotive waited the advent of a boiler having greater capacity. This came when George and Robert Stephenson designed and constructed the multitubular boiler for their famous locomotive "Rocket." This boiler had a plain cylindrical shell fitted with twenty-five 3-inch copper tubes extending from end to end of the boiler. At the front end a smokebox was attached which discharged into the stack. At the back end a box-like fixture was added to constitute the firebox. The superior success of the "Rocket" over that of previously existing locomotives was due largely to the fact that its boiler gave an abundant supply of steam.

The "Rocket's" boiler fixed the general lines to be followed in the building of locomotive boilers for many succeeding years, but it did not completely solve the problem of the firebox construction. That detail was destined to take on many forms in pioneer days, and it is one which has been the subject of much debate and change in more modern times, The first tubular boiler having a self-contained submerged firebox, seems to have been that of the locomotive "Planet" built by the Stephensons for service on the Liverpool and Manchester Railway in 1830. The firebox was rectangular in plan. While the Stephensons subsequently devoted themselves to the development of this form of construction, others built fireboxes which were circular in plan, crowned by a hemispherical dome, a form well chosen to resist the stresses imposed by the internal pressure of the boiler. In the process of developing such structures, however, practice came gradually to rely for strength less upon form and more upon stays by the use of which a structure weak in form could be held in place. A firebox rectangular in plan being desirable, other forms gave way to this plan. The stability of the sides and ends of all such fireboxes was secured by the use of stay-bolts connecting the inside and outside sheet. The support of the crown-sheet proved a more difficult matter. For many years it was provided for by the application of crown-bars running over the crown-sheet either longitudinally or transversely, the latter being the more common arrangement in this country. The crown-bars were metal girders of such form as to permit them to extend across and above the crown-sheet while receiving their support from feet bearing on the upper edges of the

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*From the report of the comparative tests of the Jacobs-Shupert and radial-stay boilers.

side-sheets. A series of such crown-bars served as lines of support for the crown-sheet which was held up by suitable rivets or bolts. The crown thus supported was in effect carried by the side-sheets, and while this type of construction proved serviceable for many years and is still used in small boilers, the time came when in the development of the American boiler it had to give way to something better. As the dimensions of fireboxes increased, the crown-bars became enormously heavy, and the load which they imposed upon the side-sheets became so great as to complicate the problem of firebox maintenance. In this emergency a part of the load was for a time removed from the side-sheet by carrying heavy sling stays from the crown-bars to the outside shell of the boiler, but the relief thus obtained was only partial, and the size of boilers continued to increase. For a time and to a very limited extent in this country, the crown-bar boiler was followed by the Belpaire boiler, a design in which all portions of the firebox are stayed, and in which the outside of the boiler is so formed as to permit all stays to connect sheets which are parallel. But the real successor of the crown-bar boiler has been the radial-stay boiler, in which the crown of the firebox is curved to a form which will permit its being held up by stays extending to the outside shell or wrapper sheet. The lines of the stays extended do not necessarily radiate from any single point, but their arrangement suggests such a possibility; hence the term "radial stays." As compared with the Belpaire, the radial-stay type presents great difficulty to be overcome in making an analysis of the stresses which are set up in its several parts by the presence of internal pressure, but it is lighter and probably on the whole equally satisfactory. The radial-stay firebox of the present day may have either one of two forms. It may be "wide," in which case the side-sheets extend in a straight line from the mud-ring to the curved portion of the crown-sheet, or it may be "narrow," in which case the side-sheets extend vertically for a short distance above the mud-ring, then curve outward and finally back again to meet the curvature of the crown-sheet. In either case, stay-bolts closely spaced connect the side-sheet with the outside sheet of the boiler.

Practice has developed many embellishments in the construction of this form of firebox. First, it has found that longitudinal stresses imposed upon the tube-sheet make it desirable to have a certain element of flexibility locally about the tube-sheet, and hence instead of inserting rigid radial stays at this point, two or more rows of sling stays are used. The design of these is such that while giving adequate support to the crown-sheet they offer no resistance to the movement referred to. A second embellishment is to be found in the use of button heads on the firebox end of some or all radial stays. The design of these heads is such as to provide a broad bearing for the plate upon the head of the stay, a connection which is altogether stronger than is obtained by merely screwing in the straight stay and heading it. Practice has also developed certain forms of flexible stays for use in the water-leg and higher up in the boiler. These devices are such as to permit some change in the angular position of the stay without imposing transverse stresses upon it at points near the outside. These and many other embellishments in its design have permitted the radial-stay boiler to perform a service which as measured in power output per unit weight is superior to that of any type previously employed in locomotive service, and it is this fact which chiefly has resulted in the wide use of the type. But the necessity for certain of these embellishments and the practical difficulties which are experienced in maintaining the modern radial-stay boiler suggest deficiencies in the fundamental principles underlying its design and the time will doubtless come when the large sized radial-stay boiler will entirely give way to something that is scientifically more sound. The promise of such a consummation is to be seen in the recently developed Jacobs-Shupert boiler which was first put in service in 1909. This type of boiler has in the past three years been subjected to extensive use and to elaborate laboratory tests, with results which as to maintenance cost and strength are entirely complimentary to the new design.

The Jacobs-Shupert boiler in its external form follows the general lines of the radial-stay boiler, of which it is to be regarded as a logical development. It differs radically from its predecessor in the structural characteristics of its firebox and in the means employed for supporting it. The Jacobs-Shupert firebox provides an element of longitudinal flexibility which the firebox of the radial-stay boiler does not possess, and thereby eliminates strains due to expansion which must be met by the rigid sheet of the radial-stay boiler. It makes no use of stays in side-sheets or crown, and hence abolishes completely a fruitful source of trouble which is always present in the radial-stay type of boiler. The support of the side-sheets and crown is secured by means of rivets submerged in the water-space of the boiler, no one of which can be exposed to the direct heat of the furnace. As a consequence, the strength of the Jacobs-Shupert boiler under low-water conditions as compared with that of the radial-stay boiler is vastly augmented.

WANTS A JOB—BAD.

If this citizen can handle a scoop shovel with the facility that he manipulates the "United States" language, Egan might do worse than give him a job.

November 12-1912.

Mr. Egan Superintendent
I. C. R. R. Co Watervalley Miss.

Dear sir please allow ask you a work of information and to give you space to comprehend the various ideas I will expond the nature of the case to you, I was employed in regards to Mr. W. H. Watkin as fireman 6th day of Sep. 1911 at Watervalley Miss and doeing the pandemonium strike I was commanded by Mr. Watkins in your, presence, to go to work in round house and I did as I was commanded until he could catch a panoramaan of what was going to take place in the comeing future after a short while I was placed back in my former occupation (extra fireman) and the winter was so much noted for its problematical changes and its radical coldness and excessive raines that scarcely enough work was carried on for a extra fireman to make over two trips per month I tried to hold on as long as possible but after all was compelled to retire from my Beloved occupation on account of lack of means of my financial surports to my wife so I sign my time check and abandoned my occupation and went to work Else where and after getting my self in shape in means of financial disposition I returned with hopes of securing the the same position that I had previously. But found Mr. W. H. Watkin Reluctant to give me the job I retired a second time from Watervalley Miss so after a long meditation over the matter I conceived a new idea that is if I can gaine favor with you as I admit to you being Expert in all things and I know your words are plenipotence and just one word of intercession will congratulate me ever so much, and for this cause I most earnestly Beseech you to entreat Mr. Watkins for me and I will reimburse for your kindness by Being one of the Best Dutifullist Serviceable collord hands that will be in my capacity now Mr Egan believe me I am more than desirous of holding the capacity as a fireman under your command thats (affidavit) and would be glad to have you in getting back in this job as I feel my self Exonerate.

Hoping a prolific reply from you I remain your servant at your command

Ben Jones Canton Miss.

ps find stamps for reply

Collord

—Illinois Central Magazine.

SHOP ARRANGEMENTS AND FACILITIES.*

By I. S. Downing, M. C. B., L. S. & M. S. Ry.

There has been so much written with regard to car shops that I fear I will not be able to add much to what has been said and will refer to freight car shops only.

There are a great many things to consider in building car shops to meet the present conditions; the class of equipment is changing very rapidly, not only the wood cars being replaced by steel, but the different parts of cars being strengthened, and even on cars built within the last five years changes are being made. The capacity and location is important. The centralization of repairs in one large shop cannot be done, as the law will not permit the handling of cars with safety appliance defects beyond repair points, except they be run in non-revenue trains, and the running of non-revenue trains to move bad order cars to large shops is not economical or good practice. Under these conditions it is necessary to build shops at practically every terminal on the line; however, it is possible to centralize to a great extent. Heavy steel car work need not be done at all terminal shops, but such cars can be moved to one central shop. Shops should be located at or near the point where cars are made empty. The unloading point for self-clearing hopper and gondola cars is principally at the harbors. This class of shops should not be located in congested districts; however, they should be so located that yard engines can promptly handle cars to and from the shop and delivery tracks. Bad order storage tracks should be a part of the shop yard and of equal capacity of shop and repair tracks. By providing sufficient storage, the switching yard is relieved and the shop is always supplied with bad orders, and conveniently located so the shop engine can handle without waiting on yard engines, which, in my opinion, never have any time for switching shop tracks. While conditions will not permit the complete centralization, I do believe on roads having mixed equipment of wood and steel cars, that where more than one shop is built, it is not necessary to fully equip each shop for repairs to either class of cars. One shop should be provided with a crane and furnaces for heavy repair work to steel cars and only a limited amount of machinery for repairs to wood cars; the other shop should be fully equipped for making repairs to wood cars and only a limited number of tools for steel car work, no crane being required in the wood car shop. However, the building should be constructed for the future installation of a crane.

Capacity of Shops: The number of cars, class of cars, also the age of equipment, must be considered in arriving at the capacity of the shop. Below is a statement showing the average time between shoppings for general repairs of various classes of cars, also a statement showing the number of hours for repairs to the different classes of cars—general and medium:

Class	Average time between shoppings	Average number of hours to repair General	Medium
Steel cars	10 to 12 years	609	85
Steel underframe	8 years	232	42
Wood	6½ years	149	54

We believe these figures are reliable, as most of them are actual. With this data it can be easily determined what size shop would be required to take care of the general repairs to equipment. Light running repairs should be considered separate.

Figure 1 shows a yard layout which I consider a very good layout for general freight car repairs. The erecting shop in this layout will hold 96 cars and the capacity of the repair tracks is 200 medium. Four tracks in this shop will be set aside for heavy repair steel work and will be provided with a traveling crane. In addition to the cranes, the complete layout, as you will note, is supplied with industrial tracks. This shop is built with the idea of taking care of wood and steel cars, but is so arranged that as the steel car equipment increases, the facilities for this class of work can be increased.

Below is a statement showing the supervision required:

Clerks for Main Office.

1 chief clerk.
1 assistant chief clerk.
1 stenographer.
1 billing clerk.
1 cost clerk.
1 stenographer and file clerk.
1 timekeeper and lot order clerk.
2 clerks for reports.

*A paper read before the Car Foremen's Association of Chicago.

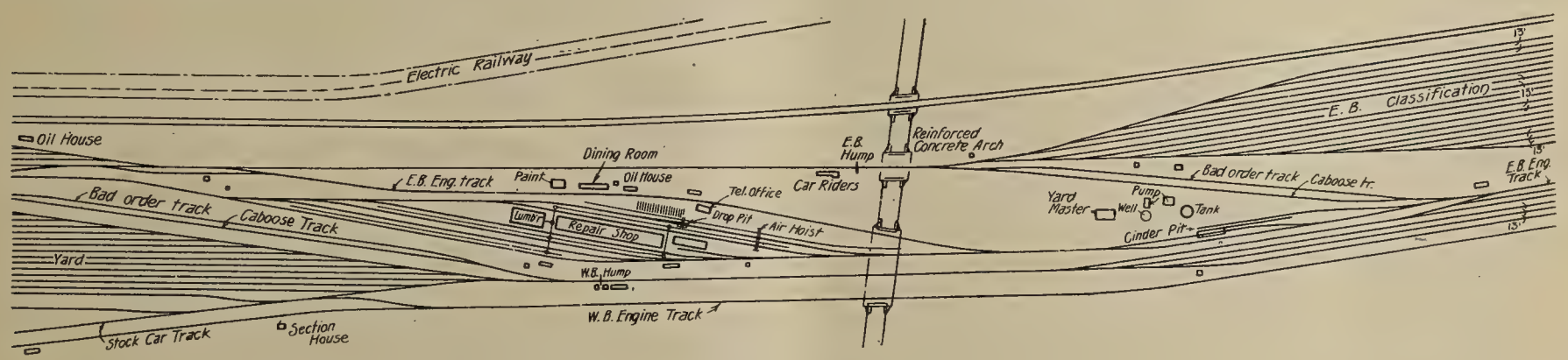


Figure 1—Layout for Freight Car Repairs.

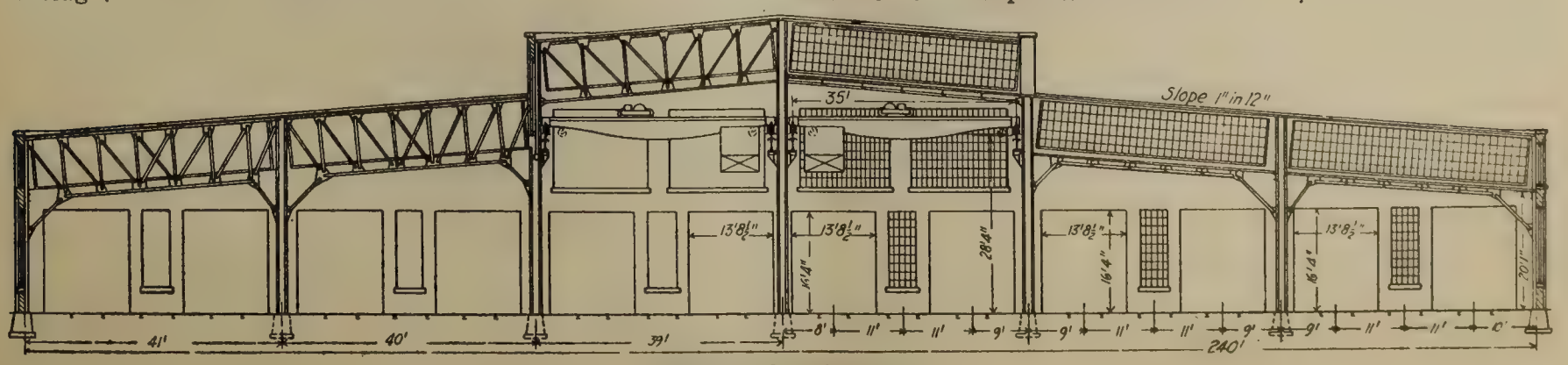


Figure 2—Storehouse.

1 office boy.
1 messenger.

Clerks for Shop Office.

1 clerk for assistant general foreman.
1 stenographer for assistant general foreman.
1 clerk for general work.

Supervision for General Car Shop.

1 general foreman.
1 assistant general foreman.
1 foreman.
1 assistant foreman.
1 truck foreman.
2 piecework inspectors.
2 repair work inspectors.

Supervision for Medium Repair Track.

4 foremen.
4 piecework inspectors.
4 repair work inspectors.
1 M. C. B. car carder.

Following is a list of tools required for the various shops:

Wood Mill.

1 4-side planer.
1 small band saw.
1 large cut-off saw.
1 swing cut-off saw for scrap.
1 jointer.
1 small planer.
1 wood lathe.
1 gainer.
1 surfacer and matcher.
1 large band saw.
1 large rip saw.
1 small cut-off saw.
1 combined gainer and borer.
1 large vertical borer.
2 heavy vertical mortisers.
1 tenoning machine for sills.
1 band saw filer and setter.
1 planer knife grinder.
1 hollow chisel grinder.
1 circular saw gummer and grinder.
1 circular saw setting machine.
1 grindstone.
1 emery wheel, double.
1 medium rip saw.

Machine Shop.

1 lathe.
2 6-spindle nut tappers.
1 tire lathe.
1 double head drill press No. 4 socket-rail, large enough for three heads.
1 single drill press No. 4 socket.
1 single drill press No. 3 socket.
2 triple head bolt cutters, 1½ ins.
1 triple head bolt cutter, 2½ ins.
1 shaper.
1 twist drill grinder.
2 double emery wheels.
1 grindstone.
1 journal lathe.
1 nut tapper, 6-spindle, semi-automatic.

Blacksmith Shop.

1 punch.
1 Bradley hammer.
18 forges.
1 combination punch and shear.
1 bulldozer.
3 furnaces, different sizes.
1 1500-pound steam hammer.
1 Bradley hammer.
1 face plate, 6x10 ft.
1 emery wheel.
1 alligator shear for 1½-in. iron.
1 test rack.
2 pipe threading machines, for small and large pipe.
1 pipe threading machine, for right and left thread.

Brake Beam Shop.

1 shear.
6 forges.
1 furnace, 3x7x4 ft. high.
1 coupler pocket press.
1 small drill press.

Door Shop and Dry Lumber Shed.

1 cut-off saw.
1 rip saw.
1 boring machine.
1 swing saw.

The supervision for the general car shop is the supervision inside the general repair shop and the supervision for medium repair track is to cover tracks outside of the building. One office force can handle the work for the entire plant. Figure 1, I believe, would be a good plant to install at most any central point for general and medium repairs.

Figure 2, you will note, shows a storehouse of two stories. The upper story of this building will be used for offices and mess room for the employes. You will also note provision is made on the scrap dock for a brake beam repair plant, where all beams, for the entire line, will be sent for repairs.

While the class of shop, referred to above, is important, the repair shop for light medium and light running repairs is of more importance than the general repair shop, for the reason that cars which it is necessary to set out of trains for this class of repairs are mostly loaded cars, or empty cars which are in great demand, and for that reason the management should be liberal in providing plenty of shop room and shop facilities in each yard for taking care of this class of repairs.

Light, medium and running repair shop should be located conveniently to a switching yard, and where room and yard layout will permit, should be located centrally in the yard, or

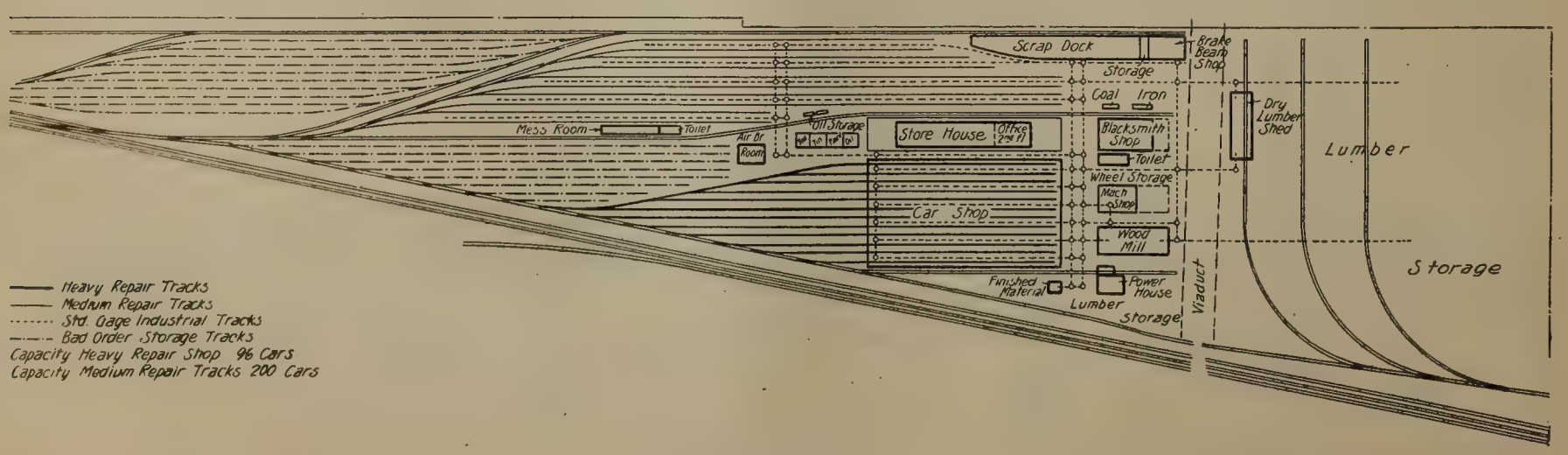


Figure 3—Car Shop Layout.

where cars can be handled to repair tracks with the least movement. Consideration should be given to further expansion. There are many light repair tracks where the switching yard has been built around the shop, making it impossible to increase the capacity of the light repair branch and in these yards it has been necessary to place additional repair yards at points which are not convenient, which also means additional supervision and extra switching to place the cars. The light repair branches are of the utmost importance, as cars must be repaired promptly to keep freight moving. They also keep light and medium r-pairs out of the general repair shop. A great deal more thought should be given to this class of shop than has been given in the past. These shops bear the same relation to the general repair shop that the roundhouse does to the back shop.

Figure 3 shows a very good layout for this class of work. While this shop is intended for light and medium repairs, it is possible to give cars a general overhauling, but, of course, heavy repairs should not be made at this shop where there are sufficient light repairs to keep the men employed. The track capacity of these light repair shops, when built, should be about double their present requirements, as there is nothing lost in building a yard larger than the present requirements, for if half the yard is not used for repair work it can be used to store bad order cars placed for repairs. This would keep the switching yards clean of bad order cars. It is not necessary to go into details regarding tools used for this class of shop, but we do know that it is a paying investment to have plenty of good tools, such as jacks, bars, etc., for the men to work with. Plenty of good tools means a better output and good natured lot of repairmen. The time is past for setting off a couple of box cars with bolts, brasses, etc., and calling it a repair yard. Equipment today, with the heavy draft gears, ends, trucks, roofs, etc., requires shops and shop tools and machinery to make repairs, and the maintenance of equipment will be with us always and we will have to provide facilities to take care of same.

The following general considerations should be pointed out:

1. Exercise care in buying machinery for repairs to wood cars, as it will not be required many years.

2. The use of steel wheels under freight cars makes it necessary to have steel tire lathes at all repair yards to avoid shipping wheels and to keep stock down to minimum.

3. Very little heat, if any, is required in freight repair shops.

4. All new cars to be purchased, to be built entirely of flat plates, commercial rolled shapes and castings.

5. All cars in existence to have parts which fail, replaced when possible by parts made of flat plates, commercial shapes and castings.

6. Shops to be provided with facilities for duplicating simple parts of present cars in cases where it is not possible, desirable or permissible to change their design.

7. In territory where weather conditions are such that men cannot work outside, shop buildings should be provided for doing the work under cover.

THE MISSOURI PACIFIC—Iron Mountain system is establishing demonstration farms to co-operate with the farmers along its line. Three of these farms are in Arkansas and two in Louisiana, and they range in size from 25 to 40 acres. Each farm will have a resident manager and is located along the tracks of the company's lines, close to a town. These farms will be modern in every respect and efforts will be made to help farmers in the surrounding country.

BUTTE, ANACONDA AND PACIFIC 2,440-VOLT RAILROAD ELECTRIFICATION.

The electrification of the Butte, Anaconda & Pacific Railway is of exceptional interest because it represents one of the largest installations of electrical equipment for steam railway service and the first in this country where 2,400-volt direct-current locomotives will be employed. Construction work necessary to effect the change from a steam to an electrically operated road is now progressing actively, and it is hoped that the entire electrification work will be completed and the electric operation commenced early in the year.

The section of the road to be equipped is that between Butte and Anaconda, Montana, comprising about 30 miles of main line single track and a total single track mileage, including the sidings, yards, smelter tracks, etc., of approximately 114 miles. The remaining 24 miles of track, embracing the mine tracks on Butte Hill, minor sidings, etc., will continue to be operated by steam; although it is probable that the entire system will be electrified at an early date.

The 2,400-volt direct-current system was adopted by this road after a careful and exhaustive study of local conditions. In comparison with other existing systems, it was found best suited for the heavy steam road service handled over its tracks. The main line trains of the Chicago, Milwaukee & St. Paul (Puget Sound Lines) run over the Butte, Anaconda & Pacific track for a distance of 16 miles, which calls for trunk line freight and passenger service in addition to the heavy local freight traffic. The haulage of freight consists principally of copper ore from the Butte mines to the smelters at Anaconda, and with mine supplies, lumber, etc., moving in both directions, amounts to approximately 5,000,000 tons of freight per year. Complete trains, weighing 3,400 tons and made up of 50 loaded steel ore cars, will be handled by two locomotives against a ruling grade of 0.3 per cent. Single locomotives will be used for making up trains in the yards and for spotting cars.

The entire electrical equipment of this installation is being furnished by the General Electric Company. Seventeen 2,400-volt direct-current locomotives of the articulated truck type, each weighing 75 tons, have been ordered. Each locomotive will be equipped with four GE-229, 1,200-volt, commutating-pole, twin-geared railway motors insulated for operation two in series on 2,400 volts. The motors are designed throughout to secure exceptionally good ventilation, and a forced circulation of air will be employed in addition to the ventilation secured by the fan incorporated in the armature. Control of the motors will be effected through special Sprague-General Electric type M control equipments, a dynamotor being employed to furnish 600 volts for the operation of the contactors, lights and air compressor. The dynamotor will have two windings, 1,800 volts and 600 volts, and will be direct-connected to a blower for ventilating the motors. Heating of the locomotive cabs will be accomplished by means of special heaters using 2,400-volt direct-current direct from the trolley circuit.

Two of the quota of locomotives are designed for passenger service. A schedule of eight passenger trains per day, four each way, is maintained for local traffic, and the average train is composed of a locomotive and three standard steam road passenger cars. The passenger locomotives will be duplicates of the freight locomotives, except that they will be geared for higher speed. When hauling a train of three coaches, they will be capable of running 45 miles per hour on level track. Current for lighting the cars will be taken from the 600-volt circuit of the dynamotor, and for heating the coaches will be tapped from the 2,400-volt trolley circuit on the locomotive.

Two 2,400-volt substations are being installed, one at Butte and the other at Anaconda, 26 miles apart. Duplicate equipments are to be installed in the two stations and will

each consist of two 1,000-kw. synchronous motor-generator sets, each composed of two 500-kw., 1,200-volt compound-wound, compensated, commutating-pole generators insulated for operation in series at 2,400 volts, direct-connected to a 1,450-kv-a., 2,300-volt, three-phase, 60-cycle synchronous motor; also two 50-kw. induction motor exciter sets, and alternating-current and direct-current switchboards. Power for operating the motor-generator sets will be supplied from the 2,300-volt, 60-cycle, three-phase buses in the substation of the Great Falls Power Company, to which power is transmitted at 50,000 volts from the hydraulic power stations of the company.

A TA regulator will be installed in each substation to maintain constant voltage automatically at the terminals of the synchronous motors. Through this method of operation the possibility of the sets dropping out of step on extreme overloads will be eliminated. The direct-current switchboard will follow standard practice for 1,200 volts with remote control circuit breakers and switches. The feeder circuits and generator circuits will be protected by 2,400-volt direct-current aluminum-cell lightning arresters.

Current for operating the locomotives will be taken from the overhead conductors. A special flexible catenary trolley suspension will be used over the larger part of the line, with direct suspension over some of the difficult sidings, smelter tracks, etc. Side brackets and cross span construction will be employed where local conditions demand. Numerous yards are to be electrified and at one point it will be necessary to span twelve tracks, which will be accomplished by cross span construction, using a third pole between the eighth and ninth tracks. 2,400-volt M E lightning arresters will protect the overhead lines.

The Butte, Anaconda & Pacific is a most important link in one of the big transcontinental railway systems and its electrification is attracting widespread attention. The fact that the substations are located 26 miles apart and but a moderate amount of feeder copper is required, notwithstanding the heavy traffic handled, strongly emphasizes the advantages of the high-voltage direct-current system. It is safe to predict that the operating results secured on this road will be closely watched by all the great systems having similar difficult situations where their lines cross the Great Divide that separates the western plains from the Pacific Coast.

PROGRESS IN SMOKE ABATEMENT.

An International Smoke Abatement Exhibition and Conference was held in London between 23rd of March and 4th of April, 1912, at which information was collected as to how far each country has advanced in the matter of dealing with this evil. The exhibition was very instructive, as it included practically every class of appliance of any value for smoke reduction that is now known to the world. The resolutions adopted by so representative a gathering will no doubt carry great weight, and we therefore give them in substance: (1) As there is a proposed bill pending in the United Kingdom for amending the existing laws in relation to smoke, a number of resolutions were passed relating to the clauses of this bill; (2) there should be a standard method of measuring the quantity of soot and dust that falls and also the density of smoke; (3) stokers should be educated and practically trained in their work and should be furnished with certificates of efficiency; (4) a Royal Commission should be appointed to enquire into the whole subject with a view to amendment of existing laws against smoke; (5) as the Pittsburgh University is engaged upon a study of the economic aspects of smoke abatement, the cooperation of societies in other countries should be afforded to advance the study.

In Hamburg there is a Smoke Abatement Society, which is a voluntary association of fuel users formed for the purpose of dealing with the smoke trouble among themselves. They employ a chief engineer, three engineers, and five instructors, who inspect the boiler plants in Hamburg and its vicinity three times a year, examine any special appliances that may be in use, teach the stokers what they should do, and make tests of the efficiency and economy of installations with reference to smoke consumption. If a change of fuel is advisable they indicate the fuel best suited to the furnace, or they advise what parts of a furnace need alteration to suit the fuel employed. In this manner improvements are effected without friction and a rivalry is established tending to make each member of the Society aim at keeping his installation above public criticism. There are, of course, State regulations on the subject throughout the German Empire, but more is effected by such organizations as exist at Hamburg than by legal measures. In the United Kingdom, too, it is recognized that no advance can be effected without a course of teaching to stokers, and therefore classes have been started at the London Borough Polytechnic Institute, and a system of lectures inaugurated at many of the large manufacturing centers. This is all under the initiative of societies which, as in Germany, are effecting more good by their propaganda than the rigors of the law can effect. Gas is rapidly displacing solid fuel for cooking and heating purposes; and this alone is effecting more good than any other measure because the methods of smoke prevention in factories are not applicable to domestic fires, and it is the latter that are accountable for more of the smoke in the Kingdom than all the factory chimneys put together. The effect upon the atmosphere may be judged from the following record of London fogs:

Period.	Average per year. Days with fog.
1883-4 to 1891-2	29.9
1892-3 to 1900-1	20.7
1901-2 to 1909-10	10.6

Fogs, it will be seen, are now reduced in number to one-third what they used to be thirty years ago; and the statistics of throat and chest complaints would show a similar improvement. It is, of course, perfectly well known now that these diseases are dependent upon the amount of impurities of an irritating nature in the atmosphere; they used formerly to be attributed to the fogs, but we are wiser and have learned that the fogs themselves are created by the smoke, and that the irritations arise, not from the fogs, but the smoke with which fogs are associated.

As regards America, reference has been made to the work of the Pittsburgh University where a small commission of scientists are collecting data as to the increased cost of living and the losses to manufacture caused by smoke, the effect of smoke upon health and plant life, the effect on buildings, statuary and paintings, and lastly its effect in relation to sunshine and fog. They hope to bring home to the mind in such practical ways the immense amount of evil smoke really causes and thus to rouse the whole country into a campaign against it. It had become so huge an evil in Chicago that at last, in 1907, a commission was created composed of a strong body of business men with large powers. The working staff of the Commission consists of 22 engineers and clerks with a large number of smoke inspectors. The Commission has power to inspect all plans of installations and reject any that are likely to create a smoke nuisance; they can make suggestions for the improvement of defective plant and impose fines if their suggestions are neglected. They have thus been able, in a period of only four years, to reduce the nuisance to a third of its former dimensions. Boston records a similar experience where, without the help of the legislature, and in fact in spite of it when it was found to support the smoke producers, a Committee of the citizens managed, by collecting and diffusing among fuel users the facts regarding smoke abatement and the

losses arising from smoke, to so leaven public opinion that Boston is now said to have as little smoke annoyance as any city of its size in America. In the case of factory smoke the main evil is an inadequate air supply and an imperfect mixture of the air with the escaping gases. With hand-fired boilers, therefore, it is recommended that automatic devices be always employed for a regulation of the air to meet the varying demands of the furnace. As coals differ so much in their properties, the coal that from its availability must be used in a certain furnace must govern the furnace best suited to burn it, and the air supply necessary for complete combustion must be determined by actual test. For this purpose apparatus for testing Co_2 has to be installed and also apparatus for measuring smoke emission. It will thus be seen that when a smoky coal must perforce be used no haphazard methods will prevail, there being no such thing as guessing that this coal and that furnace will make a satisfactory combination. With anthracite they may, but with bituminous coal practically never. In the case of domestic fires the handling of bituminous coal is difficult; and it is therefore a healthy sign that coal fires are rapidly giving place to gas and electricity.—*Indian Engineering.*

New Books

RAILROADS: RATES AND REGULATION. By William Z. Ripley. Cloth, 6x9 inches, 660 pages with 41 maps and diagrams. Published by Longmans, Green & Co., New York. Price $3.00.

This work is by a man well known for his work in connection with the study of problems affecting the regulation of railways. As stated in the preface, it is the outcome of a continuous personal interest in railways since the time when the Federal government first participated in their affairs. Quoting the author, "Through all these years the conviction has steadily grown that, as one of the most fundamental agents in our American economic affairs, the subjection of transportation to public control was a primary need of the time. An earnest effort has been made to set down the facts concerning this highly controversal subject with scientific rigor and with fairness to all of the great parties concerned, the owners, the shippers and the people."

The subject of railway rates and regulation is of vital interest to each of the three classes mentioned, and to one who wishes to obtain a comprehensive view of the situation, this work is to be highly commended. It covers its subject in detail and is written in terms which are readily understandable. The book contains twenty chapters, and the subjects include the history of transportation, theory and practice of rate making, discrimination, problems of routing, special rate problems, movement of rates since 1870, the Hepburn Act, the Mann-Elkins Act, the Commerce Court and the conflict of State and Federal authority. A second volume is to follow the present one, dealing with matters of finance and corporate organization.

* * *

BOOK OF STANDARDS. Leather, 4x6½ inches, 560 pages. Published by the National Tube Co., Pittsburgh, Pa. Price $2.00.

This is one of the most commendable volumes of this nature which has come to our notice. It is printed on Canterbury Bible paper and fits the pocket readily, as it is less than five-eighths of an inch thick. It is bound in maroon colored, flexible leather, with gold lettering and the information contained makes it a complete pipe handbook. Several pages are devoted to a description of the processes of manufacturing both welded and seamless pipe and to a description of the physical properties of "National" pipe and Shelby seamless steel tube. There is contained descriptions, tables and data concerning all kinds of pipes, fittings and tubes.

Considerable prominence is given to articles on strength of tubes and cylinders under internal fluid pressure and collapsing pressures. Both of these papers are very complete and have been extracted from papers by Prof. R. T. Stewart, dean of mechanical engineering department, University of Pittsburgh, and read by him before the A. S. M. E. Several of the formulas are compared and results of actual tests are given. An article on safety factors and safe working stresses is given, which shows through what ranges values should be used for safe operation. Chapters are supplied giving information in regard to water, gas, steam and air, It has not been the intention to go very deeply into these various subjects, only in so far as they concern tubular products.

A glossary of terms used in the pipe and fittings trade will be found in the back of the book and in many instances the meanings of many of the more or less well known words used in this trade are defined.

* * *

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION. Proceedings of the twentieth annual convention. Cloth, 6x8½ inches, 350 pages. Published by the association under the direction of A. L. Woodworth, secretary, Lima, O.

This volume contains the proceedings of the convention held at the Hotel Sherman, Chicago, on August 20-23, 1912. These proceedings cover the following subjects: "History of Iron Working," "Flue Welding," "High Speed Steel," "Drop Forgings," "Case Hardening," "Frame Making and Repairing," "Heat Treatment of Metals," "Piece Work," "Shop Kinks" and "Shop Efficiency." Included in the above are a number of letters giving the personal experience of the members. A copy of the constitution and list of members are also printed.

* * *

AMERICANS IN PANAMA. By William A. Scott. Cloth, 5½x8 inches, 258 pages. Published by the Statler Publishing Co., New York.

One of the greatest engineering feats of the present day is the Panama Canal, and Americans feel proud of the manner in which that great undertaking has been accomplished. Many have made the trip to Panama to view this work before the water is turned in, but for those who cannot make the trip the book affords a good insight into the work. The author spent five months on the Isthmus, three of which were spent as an employe of the Isthmian Canal Commission.

Personals

E. Fuller succeeds B. McBride as master mechanic of the Southern at Charleston, S. C.

B. McBride, master mechanic of the Southern, has been transferred from Charleston, to Columbia, S. C., succeeding C. G. Arthur.

C. L. Bunch has been appointed general foreman of the Southern at Spencer, N. C., succeeding E. Fuller.

J. S. Osmer has been appointed superintendent of motive power of the Ann Arbor with office at Owosso, Mich. He succeeds G. E. Coutant.

J. B. Randall has been promoted to master mechanic of the Louisville, Henderson & St. Louis with office at Cloverport, Ky.

G. O. Hammond has been appointed assistant to the mechanical superintendent of the New York, New Haven & Hartford with office at New Haven, Conn.

F. T. Chase has been appointed master mechanic of the Missouri, Kansas & Texas at Smithville, Tex.

R. T. McGraw has been appointed superintendent of the fourth division of the Denver & Rio Grande (Colorado Lines), with headquarters at Alamosa, Colo., succeeding I. H. Luke.

H. M. Young has been appointed road foreman of engines of the Erie. His office is at Huntington, Ind.

R. J. Lockett has been appointed superintendent of transportation of the Fort Worth Belt, succeeding W. S. Woodward. His office is at Fort Worth, Texas.

C. A. Steiner succeeds H. H. Berry as superintendent of the George's Creek & Cumberland, with office at Cumberland, Md.

C. G. Bowker has been appointed general superintendent, eastern lines of the Grand Trunk, including the Montreal division and terminals, the Belleville division and the Ottawa division. His office is at Montreal, Que.

H. E. Whittenberger has been appointed general superintendend, Ontario lines of the Grand Trunk, with office at Toronto. These lines include the Toronto Terminals, and the Barrie, Hamilton, London, St. Thomas and Stratford divisions. Mr. Whittenberger's office is at Toronto.

U. E. Gillen has been appointed general superintendent of the western lines of the Grand Trunk, with office at Chicago.

Albert E. Gowenlock has been appointed locomotive foreman of the Great Northern at Casselton, N. D. He succeeds J. T. Murtinger.

W. Brennan has been appointed car foreman of the Great Northern at Kelly Lake, Minn.

Frank West succeeds G. H. McCutchin as master mechanic of the Hayneville & Montgomery, with office at Hayneville, Ala.

W. H. Rose has resigned as master mechanic of the Cincinnati, Hamilton & Dayton at Indianapolis, Ind., to become mechanical superintendent of the Procter & Gamble Co. Mr. Rose has had a very interesting career. He was born in Jackson county, Kansas, in a sod house on the edge of the Pottawatomie Indian Reservation Aug. 25th, 1875, and received a common school education by riding 4 miles to school on horseback. When 16 years old the Chicago, Kansas & Nebraska Railway built a road through the county near his home and the sight of one of their engines so interested him that one day he saddled his little Indian pony and started for Horton, Kansas, the headquarters of the road, which is now the Rock Island Route. After riding all day and all night he arrived at Horton and went to the superintendent of motive power, H. Monkhouse. Mr. Monkhouse turned him over to General Foreman John Gill. He took an apprentice course covering 4 years and at the same time attended a night school and completed a course in mechanical drawing. After completing his apprenticeship of 4 years he was given full charge over the air brake department. He held this position for nearly 3 years. In 1898 he accepted a position with the D. L. & W. at Scranton, Pa., as foreman. In 1899 he was promoted to round house foreman at Buffalo, N. Y. He then accepted a position as assistant round house foreman at St. Joseph, Mo., for the C. B. & Q., and in 1902 he was promoted to shop demonstrator, assisting in the installation of piece work in the machine shop as well as the car shop. In 1905 he went to the Wabash at St. Louis as general foreman of the locomotive and car department. In 1907 he was appointed assistant master mechanic of the Cincinnati, Hamilton & Dayton, at Cincinnati, Ohio, and in 1909 he was promoted to master mechanic. In 1912 he was transferred to Indianapolis, there having charge of the Cincinnati, Indianapolis & Springfield division. On the occasion of leaving for his new work he was presented with a diamond ring.

Chas. E. Strain has been appointed general foreman of the Hocking Valley at Logan, O., succeeding W. F. Cremean. Mr. Strain entered the car department of the Hocking Valley at the age of twenty. After several changes he was appointed erecting shop foreman in April, 1912, which position he held until his present appointment.

John Jacobs succeeds A. Ziebold as foreman car repairs Hocking Valley at Columbus, O.

M. D. Stewart has been appointed master mechanic of the Houston Belt & Terminal, with office at Houston, Texas. He succeeds R. Fitzsimmons.

R. A. Foresman has been appointed superintendent of power of the Interurban Ry., succeeding J. E. Rolston. His office is at Des Moines, Ia.

J. McGillivray has been promoted from superintendent to general manager of the Inverness Ry. & Coal Co., with office at Inverness, N. S.

J. H. Schroder succeeds R. W. Owens as master mechanic of the Jonesboro, Lake City & Eastern. His headquarters are at Jonesboro, Ark.

H. W. Sheridan has been appointed general superintendent of the Iberia & Vermillion, with office at New Orleans, La. He succeeds W. M. Hobbs.

W. A. Larick has been appointed road foreman of engines of the Lake Shore & Michigan Southern, with office at Toledo, O. He succeeds Geo. M. Broker.

Evan Jones has been appointed general manager of the Laurel Fork, with office at Hampton, Tenn.

W. A. Cary succeeds R. L. Matthew as master mechanic of the Live Oak, Perry & Gulf, with office at Live Oak, Fla.

H. Hall has been appointed general superintendent of the Louisiana Southern. His office is at New Orleans, La.

W. N. Green has been appointed assistant master mechanic of the Louisville & Nashville at the Boyles shops, near Birmingham, Ala.

Harry Feathars succeeds Henry Hardie as master mechanic of the Louisville & Nashville at Corbin, Ky., to Howell, Ind.

Harry Hardie, master mechanic of the Louisville & Nashville, has been transferred from Corbin, Ky., to Howell, Ind.

A. A. McGregor, master mechanic of the Louisville & Nashville, has been transferred from Howell, Ind., to the Boyles shop, Birmingham, Ala.

G. H. Fordham succeeds T. C. McWilliams as superintendent of the Mississippi Eastern, with office at Quitman, Miss.

John T. Suggs succeeds M. Dailey as superintendent of the Missouri, Oklahoma & Gulf Ry., of Texas, with office at Denison, Tex.

A. Schlitz has been appointed road foreman of engines of the New York Central & Hudson River, succeeding E. J. Clements, with office at West Albany, N. Y.

M. Castillo has been appointed master mechanic of the National Rys. of Mexico, with office at Mexico, D. F.

Geo. W. Stubbs succeeds J. J. Hazel as master mechanic of the Ocilla Southern at Ocilla, Ga.

J. F. McCurdie has been appointed master mechanic of the Pascagoula-Moss Point Northern at Moss Point, Miss. He succeeds H. Sylvis.

W. R. Oneill succeeds W. S. Jones as master mechanic of the Payette Valley, with office at Payette, Ida.

Ivy L. Lee, formerly in charge of publicity work of the Pennsylvania, has been appointed executive assistant, with office at Philadelphia, Pa.

S. C. Hoge has been appointed inspector of transportation of the Atlanta, Birmingham & Atlantic, succeeding J. H. Elliott. His headquarters are at Atlanta, Ga.

R. N. Begien has been appointed a general superintendent of the Baltimore & Ohio, with office at Baltimore, Md.

G. D. Siemantel has been appointed master mechanic of the St. Louis, Rocky Mountain & Pacific with office at Cimarron, N. M. He succeeds J. P. Peach. Mr. Siemantel was born March 6, 1883, at Peru, Ind., graduated from high school at Ottawa, Kans. in 1899, at the age of 16, and started to serve a machinist apprenticeship with the Santa Fe at the same place. At the same time he took a course in mechanical engineering with the International Correspondence School and completed his apprenticeship in May, 1903. He entered Purdue University in

G. D. Siemantel.

September, 1903, taking the mechanical engineering course. In 1906 he left college and entered the service of the Santa Fe Lines as shop and bonus expert on the A., T. & S. F. proper, later being promoted to the position of power expert. In October, 1907, he was transferred to the mechanical department of the same road and held positions as round house or general foreman at Chicago, Ill., Las Vegas, N. M., Clovis, N. M., Amarillo, Tex., and Raton, N. M., until September, 1912. He then resigned to enter the automobile business, in which business he continued until November 18, 1912. when he was appointed to his present position, where he has charge of both mechanical and stores departments.

J. B. Dougherty succeeds T. F. Dreyfus as master mechanic of the Baltimore & Ohio at Benwood, W. Va.

M. J. McCarthy has been appointed superintendent of motive power of the Baltimore & Ohio Southwestern and the Cincinnati, Hamilton & Dayton, at Cincinnati, O., succeeding A. P. Pendergast, promoted. Mr. McCarthy was born in Susquehanna, Pa., in 1868, and served an apprenticeship with the Erie at that point. He left there in 1889 and worked in a number of railway shops in the west and southwest as a machinist and foreman. He was with the Chicago, Burlington & Quincy for ten years, serving as machinist, inspector and foreman at Burlington, Iowa. For the next four years he was division master mechanic of the Michigan Central at St. Thomas, Ont., leaving there to become master mechanic of the Lake Shore & Michigan Southern at Elkhart, Ind. This position he resigned to become shop superintendent of the Big Four shops at Beech Grove, Ind. A year and a half ago he was promoted to assistant superintendent of motive power of the Big Four, with office at Indianapolis, which position he held until his recent appointment.

J. W. Records succeeds C. J. Drury as master mechanic of the Atchison, Topeka & Santa Fe at Amarillo, Texas.

R. J. Woods has been appointed purchasing agent of the Ann Arbor, with office at Toledo, O.

J. W. McKee has been appointed general superintendent of the Arkansas Southeastern, with office at Randolph, La.

A. P. Prendergast has been appointed superintendent of motive power of the Baltimore & Ohio, with office at Baltimore, Md.

H. G. Selby succeeds Mott Sawyer as superintendent of the Bellingham Northern, with office at Bellingham, Wash. The Bellingham Northern Ry. was formerly known as the Bellingham Bay & British Columbia R. R.

F. D. Clark succeeds T. E. Dunn as superintendent of the Cambria & Indiana, with office at Colver, Pa.

C. E. Pharris succeeds J. M. Plant as foreman of machine shops of the Southern at Columbus, Ga.

J. H. Farmer succeeds J. Forrest as locomotive foreman of the Chicago Great Western at Conception, Mo.

R. C. Cross succeeds R. Lawk as locomotive foreman of the Chicago Great Western at Mankato, Minn.

E. B. McClure has been appointed superintendent of the Sioux City division of the Chicago & North-Western, vice A. W. Towsley, resigned to accept service elsewhere. His office is at Sioux City, Iowa.

J. C. Furman succeeds J. W. Evans as master mechanic of the Pennsylvania Southern at Clarion, Pa.

H. E. Newcomet has been appointed superintendent of the Pennsylvania Terminal with office at Louisville, Ky. He succeeds T. J. Kron.

W. Harris has been appointed foreman car repairs of the Quincy, Omaha & Kansas City with office at Milan, Mo. He succeeds W. J. Carethers.

W. A. Gillespie succeeds J. F. Pinion as storekeeper of the St. Louis, Brownsville & Mexico at Kingsville, Texas.

M. D. McKinna, formerly master mechanic of the Ventura County at Oxnard, Cal., has been made superintendent of motive power at the same place.

F. Mertsheimer has resigned as general superintendent of motive power of the Kansas City, Mexico & Orient.

D. Patterson, master mechanic of the Kansas City, Mexico & Orient at Wichita, will handle all mechanical matters and the office of superintendent of motive power has been abolished.

J. H. Tinker, master mechanic of the Chicago & Eastern

J. H. Tinker.

Illinois at Danville, Ill., has been appointed acting superintendent of motive power, succeeding S. T. Park, resigned.

S. T. Park, superintendent of motive power of the Chicago & Eastern Illinois at Danville, Ill., has resigned.

George W. Robb, master mechanic of the Grand Trunk Pacific, has had his office transferred from Rivers, Man., to Transcona, Man.

John Dumphy has been appointed boiler-maker foreman of the

Chicago, Rock Island & Pacific. His office is at Argenta, Ark.

A. S. Touhy succeeds J. B. Miller as master mechanic of the Colorado & Wyoming, with office at Segundo, Colo.

I. H. Luke has been appointed superintendent of the second divison of the Denver & Rio Grande (Colorado Lines), with office at Salida, Colo. He succeeds O. J. Ogg, resigned.

Geo. V. Wagner has been promoted from superintendent of shop to master mechanic of the South Georgia & West Coast with office at Quitman, Ga.

P. Dickson has been appointed foreman mechanical department of the Stephensville, North & South Texas. His office is at Comanche, Tex.

H. B. Lord has been appointed superintendent of the Tampa & Jacksonville with office at Gainesville, Fla.

John C. Price, formerly master mechanic and roadmaster of the Tuckerton, has been promoted to general manager. His office is at Tuckerton, N. J.

R. C. Hyde has been appointed master mechanic of the Chicago, Rock Island & Pacific at El Dorado, Ark., succeeding H. J. Osborne.

C. A. Lombard has been appointed acting master car builder of the Chicago, St. Paul, Minneapolis & Omaha at Hudson, Wis. He succeeds Gustave Larson.

W. B. Bunn succeeds J. G. Lewis as general foreman of the Queen & Crescent Route at Danville, Ky.

J. G. Lewis succeeds H. L. Roth as general foreman of the Queen & Crescent Route at Ludlow, Ky.

M. C. Moore has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific, with office at El Dorado, Ark.

Among The Manufacturers

TESTS OF LOCOMOTIVE SPRINGS.

A fibre stress of 256,000 pounds per square inch at the elastic limit, constitutes, it is thought, a record for locomotive spring steel. These results were obtained in some recent tests of locomotive spring leaves made at the McKee's Rocks works of the Crucible Steel Company of America.

A comparison of the elastic limit of the chrome-vanadium spring steel, as shown in this test, with the best records for other types of spring steel, is given in the following table:

Kinds of spring steel:	Elastic Limit, Lbs. per sq. in.	Per cent. in favor of Chrome-Vanadium
Carbon, oil tempered	101,000	253
Chrome-Nickel, spring tempered	134,500	90
Chrome-Vanadium, oil tempered	256,000	..

It will be noted that, compared with the oil tempered carbon steel spring, the chrome-vanadium spring has 2½ times higher elastic limit. In other words, this indicates that under given conditions of load and design of spring, a properly heat-treated chrome-vanadium spring will give a much higher factor of safety than a carbon steel spring.

The tests of the chrome-vanadium spring steel were made upon leaves taken at random from a number of large locomotive springs being manufactured for one of the large railways for service on extra heavy locomotives. They were made in the usual course of inspection. From a pile of spring leaves shaped and tempered ready for application of the bands, three leaves were taken as representative of the entire lot. The leaves were 6 in. x ⅜ in. The load was applied at the center, the length between centers being 18 inches. Successive loads of 1,000, 2,000, 3,000 lbs. and so on in increments of 1,000 pounds were applied to all the leaves.

Leaf No. 1 had a free height of 2 3-16 ins. At a load of 4,000 lbs. it took a permanent set of 1-16 in. The elastic limit was reached at a load of about 3,500 lbs., or a corresponding fibre stress of 223,500 lbs.

In test No. 2 the free height of the leaf was 1 11-16 in. The elastic limit was reached at about 4,000 lbs., or a corresponding fibre stress of 256,000 lbs.

In test No. 3 the plate had a free height of 1⅝ in. The elastic limit was reached at about 3,000 lbs., or a corresponding fibre stress of 191,750 lbs.

The permanent sets at successive loads shown in tests Nos. 2 and 3 are given in the following table:

Load, pounds	Permanent set in inches Test No. 2	Test No. 3
1,000	none	none
2,000	none	none
3,000	none	1-16
4,000	1-32	1-16
5,000	1-16	1-16
6,000	4-16	1-16

In each case, bending of the leaves was continued under loads of from 11,000 to 12,000 lbs. until the leaves cracked. All of the leaves bent through angles of more than 90 degs. before cracking.

Spring Bent Through 117 Degrees.

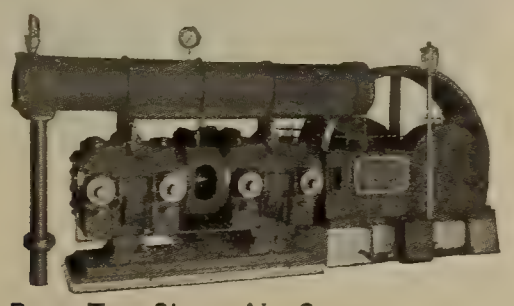
One of the leaves is shown in the illustration. This was bent through an angle of 117 degs. before it cracked. In each case the fracture showed a very tough structure. Chrome-vanadium springs offer the means of effecting a large saving in cost of locomotive maintenance by practically eliminating or greatly reducing spring failures.

BURY VARIABLE VOLUME COMPRESSOR.

The Bury Compressor Company of Erie, Pa., has recently built one of its large two-stage variable volume air compressors for the General Electric Company. This will have the motor mounted directly on the shaft, and will be installed in their new foundry, which will be the largest in the world.

Bury Two-Stage Air Compressor.

The Bury Compressor Co. was the original designer of this type of variable volume air compressor, and the first to forsee its possibilities and develop the same and perfect this new type compressor, which it has been building for the past two years,



Bury Two-Stage Air Compressor.

and the installations of those already built have exceeded the high guarantees made.

The speed of high speed steam engines has been attained with this type of compressor, with highest efficiencies and smoothness of operation.

These compressors are designed to meet variable volume conditions with high efficiencies.

The unique unloading system (patents on which are pending), together with the design of mechanically operated straight shot inlet valves and patented cushion poppet inlet and discharge valves, makes possible the operation of these machines at very high piston speeds with highest volumetric efficiency and with practically no wear on the valves, making the machine quiet in operation.

UNIVERSAL PORTABLE ELECTRIC DRILLS.

The Standard Electric Tool Co., Cincinnati, O., has developed and is now placing on the market new Universal portable electric drills in five sizes, ¼-in., 5-16-in., ½-in.,

Standard High Power Drill.

¾-in., and ⅞-in. These are in addition to their ⅜-in. size, illustrated and described in our columns at an earlier date.

These drills operate off lamp sockets on both alternating and direct currents, and they will also run satisfactorily on low frequency circuits as well as on 60 cycles. Series commutating type motors of special design are used. Extremely high power and absence of any tendency to run hot are noteworthy features, and an improved method of force ventilation is used.

A prominent feature is that these motors are non-racing, being the first Universal drills on the market that do not race when running idle or under light load. Consequently twist drills are never burned and there is no danger if tools are allowed to run idle indefinitely. A quick make-and-break switch is located in handle, placing drills under control of operator at all times.

All armature spindles run in ball bearings. In the ½-in. and ¾-in. sizes the gears are mounted on ball bearings encased in grease. All gears are supported on both ends, not studded to gear plate.

UNION COMBINED PUNCH SHEAR AND ROD CUTTING MACHINE.

A neat hand tool for the purpose of cutting rods or wire up to ⅝ in., shearing flat metal from ⅛ in. x 1 in. to ½ in. x 3 ins., and for punching holes in size up to ½ in. and in thickness up to ½ in., is made by the Union Mfg. Co., New Britain, Conn.

The machine is made in three sizes for the purpose of doing the above-mentioned work. Its operation is evident from the illustration herewith.

The three principal operations in the working of metals, punching holes, shearing sheets or flat bars, and cutting off round or square rods, are all accomplished with dispatch and accuracy by use of this machine, which embodies the three functions in one compact, strong and powerful device.

All parts of the different machines are made in accurate jigs and are positively interchangeable.

The shears will cut flat bars, or cut strips from soft steel or iron as thick as can be conveniently fed through the machine.

Union Combined Punch, Shear and Rod Cutter.

The wire gauge may be turned down opposite the shear and used as a shear gauge.

The wire cutter blades may be easily removed for grinding, and reset from the exterior of the machine by four adjusting screws for that purpose. In conjunction with the wire gauge, dowel pins and bolts may be cut in duplicate lengths.

The punch disk holds four different sizes of punches, all slightly over listed sizes (to allow clearance for rivets) and the die disk four corresponding dies, which may be quickly and cheaply replaced. It will punch holes closer to the corner of angle iron than any other machine, and the shear blades and punches may be easily and quickly replaced.

New Literature

The Standard Electric Tool Co., of Cincinnati, O., has issued Bulletin U1, descriptive of "Standard" high-power universal portable electric tools. These tools operate on both alternating and direct current, and also operate satisfactorily on low frequency circuits such as 25 and 40 cycles.

* * *

The Smooth-On Mfg. Co., of Jersey City, N. J., has issued a circular describing Smooth-On Fire Brick Cement No. 8. This cement has great fire-resisting qualities.

* * *

The January issue of The Safety Heating & Lighting News, published by The Safety Car Heating & Lighting Co., of New York, contains an interesting article on "The Economical Use and Advantages of Light."

* * *

Bulletin 34F, of the Chicago Pneumatic Tool Co., Chicago, contains a complete description of the design and construction of Class G "Chicago Pneumatic" compressors. The introduction says, "Speed and capacity ratings are conservative—we make no guarantees that a working test will not fulfill."

* * *

The Vulcan Engineering Sales Co., of Chicago, has issued several bulletins illustrating the several styles and sizes of Q M S cold metal sawing machinery. The first bulletin illustrates style "1 M" saw, which has a capacity for 6-in. rounds, squares and 10-in. I-beams. The second bulletin illustrates the "B" cut-off and universal type of metal sawing machine. Other bulletins illustrate a combination saw and rotary planer, the "A" cut-off and universal saw and the foundry type of cold metal cutting-off machines.

* * *

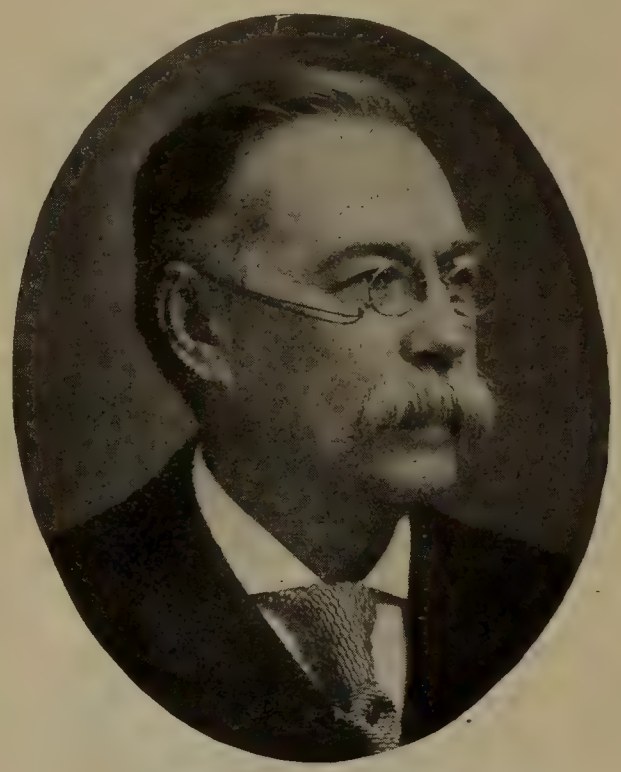
The largest and most complete production catalog ever issued by the Joseph Dixon Crucible Co., Jersey City, N. J., is now being mailed to the thousands of manufacturers, jobbers, purchasing agents and others interested in graphite, crucibles, paint, lubricants, pencils and other productions of the Dixon company. Though over one hundred pages of type and illustrations are used, this catalog does not attempt to carry a full description of the entire Dixon line and only a few of the many hundreds of Dixon's American graphite pencils are listed. The Dixon company attaches a peculiar value to its production catalog inasmuch as it serves to acquaint those who are already users of one form of graphite with its many other forms and uses.

Industrial Notes

William B. Hall has resigned as vice-president and general manager of the Illinois Car & Manufacturing Co. to promote the interests of the Union Railway Equipment Co., of Chicago, which has taken over the patented devices invented by Herman Pries, superintendent of the Haskell & Barker Car Co. Mr. Hall was superintendent of equipment of the Mather Horse & Stock Car Co., for 16 years.

F. E. Maxon, who for several years past has been connected with the sales department of the Independent Pneumatic Tool Co., at New York, died on January 8 from an attack of appendicitis.

H. M. Perry has accepted a position with Edwin S. Woods & Co., manufacturers of anti-friction side and center bearings and will devote his energies to both the mechanical and sales departments. Mr. Perry has had a wide car experience, having been connected with the Flint & Pere Marquette R. R.; Santa Fe; and Algoma Central & Hudson Bay Ry., and with all in the capacity of master car builder. Mr. Perry was connected with the Pullman Company about 1885 as general superintendent and shortly thereafter with the United States Rolling Stock Co. in the same capacity and at a later date with the Madison Car Co. as manager. After leaving the railroad work and car construction he devoted about three years to expert investigation on brake beams in service,



H. M. Perry.

then engaging in the supply business to which field he has since devoted his energies. It will probably please many of Mr. Perry's friends to know that he is now associated in a line of work wherein his previous experience will be so great an asset as it will in the line of work being pursued by the Woods Company.

J. L. Stark, general inspector car department, of the Hocking Valley Ry. and president of the Chief Interchange Car Inspectors and Car Foremens Ass'n. of America, has been appointed on the staff of representatives of the Chicago-Cleveland Car Roofing Co., with headquarters 427 Peoples Gas Bldg., Chicago.

Mr. Stark has always been connected with car work, first in the employ of the Consolidated Rolling Stock Co., being in charge of their shops at Toledo for a number of years. Later he was appointed general foreman of the mechanical department and superintendent dock department of the Cincinnati, Hamilton & Dayton. For the past five years he has been general inspector car department of the Hocking Valley with office at Columbus, Ohio. Mr. Stark is a member of the Master Car Builders' Assn., The Pittsburgh Railway Club, Western Railway Club, Car Formens' Assn. of Chicago and the Chief Interchange Car Inspectors' & Car Foremens' Assn.

Nathan B. Payne, who has been associated with Messrs. Manning, Maxwell & Moore, Inc., New York, for several years, has accepted the position of manager of sales with Davis-Bournonville Co., manufacturers of oxy-acetylene welding and cutting apparatus, 90 West Street, New York, beginning Ferbruary 1st.

Ernest C. Vehslage, president and treasurer of the Bonny-Vehslage Tool Co., died December 21, 1912.

The Standard Heat & Ventilating Co., Inc., 141 Cedar street, New York, has recently been incorporated and has bought the rights of the Ward Equipment Co., New York, and the Safety Car Heating & Lighting Co., New York, relating to car heating and ventilating, and will make and sell the devices in these special lines hitherto furnished by the two latter companies. The Safety Car Heating & Lighting Co. will also act as its agent.

George Myrick Sargent, of Evanston, Ill., the founder of the first plant in the United States for the exclusive manufacture of brakeshoes, and at the time of his death a director

of the American Brake Shoe & Foundry Co., died at Atlantic City, N. J., on January 16, at the age of 83 years.

Harry Lowman, formerly with the mechanical department of the Southern Railway at Washington, D. C., has entered the sales department of the Chicago Car Heating Co

M. E. Keig, for several years connected with the purchasing department of the Atchison, Topeka & Santa Fe Ry., has been made secretary-treasurer of the Harry Vissering Co., 20 W. Jackson Blvd., Chicago, Ill.

The Carbon Steel Co. has moved its New York offices to the 16th floor of the Cameron building, Thirty-fourth street and Madison avenue.

At a meeting of the board on January 22, 1912, J. B. Rider, general manager, was elected a director of the Pressed Steel Car Company.

Gilbert H. Pearsall, formerly secretary of Joseph T. Ryerson & Son, Chicago, Ill., in charge of railway sales, with headquarters in New York, resigned his position on January 1, 1913, to engage in business for himself. Edward T. Hendee, assistant to the president of Joseph T. Ryerson & Son, has assumed the duties heretofore devolving upon G. H. Pearsall.

William N. Thornburgh has been appointed general sales manager of the Standard Asphalt & Rubber Co., with office at 137 So. La Salle St., Chicago. In 1891 Mr. Thornburgh was made sales and traffic manager of the Cleveland Stone Co., and continued in this capacity for twelve years. From 1902 to 1907 he was president and treasurer of the Thornburgh Coupler Attachment Co., with office at Detroit, Mich. In 1907 he became vice-president of the Ohio Quarries Co.,

Wm. N. Thornburgh.

with offices at Chicago and Cleveland, which position he resigned three years later to become vice-president and general manager of the Metropolitan Engineering & Construction Co., of Kansas City, Mo. The following year he embarked in the general contracting business under the name of Kinear & Thornburgh, with offices at Columbus, O., and Houston, Tex. In his present position Mr. Thornburgh will have jurisdiction over waterproofing, engineering, mastic floor and paving departments.

The Burden Sales Company, with general offices at 30 Church Street, New York, and sales offices in Chicago, Atlanta and St. Paul, has been organized, with Gilbert H. Pearsall, president; H. H. Linton, vice-president, and Craig Graves secretary and treasurer, to be a distributor of the products of the Burden Iron Company of Troy, N. Y., exclusive of horseshoes. In connection with the general offices of the Burden Sales Company will be the eastern sales office of the Jacobs-Shupert United States Firebox Company and the Oxweld Railroad Service Company. Notice of Mr. Pearsall's election to the vice-presidency of both these companies appeared in this publication some months ago.

C. E. Allen was recently appointed assistant manager of the detail and supply department of the Westinghouse Electric & Mfg. Co., at East Pittsburgh, Pa. Mr. Allen was born in Virginia, and after attending high school, entered the Virginia Polytechnic Institute, from which he graduated in 1901. After graduation he entered the employ of the General Electric Company, taking the apprenticeship

C. E. Allen.

course. From here he was transferred to the engineering department, where he was engaged in the design of transformers, on which work he was successfully employed for several years. While in charge of this work Mr. Allen invented the "distributed core" type transformer now being manufactured by the General Electric Company. In the fall of 1909, he entered the employ of the Westinghouse Electric & Mfg. Company as head of the transformer division of the detail and supply department, which position he retained until his present appointment.

John Hoffhine, for nine years assistant chemist on the Union Pacific R. R. at Omaha, has accepted an appointment with the American Brake Shoe & Foundry Co., with headquarters at 30 Church street, New York City, effective February 1. Mr. Hoffhine was born in Ohio 31 years ago. Immediately upon graduation from the Ohio State University in 1904 he entered the testing department of the Union Pacific at Omaha, where he soon advanced to the position of assistant chemist, with complete command of the chemical and physical testing laboratories. He conducted exhaustive tests and analyses of the Associated Line steel rails, and under the direction of W. R. McKeen, Jr., former superintendent motive power and machinery, Mr. Hoffhine had charge of the material testing and research work in connection with the Harriman Lines standardization of passenger cars, freight cars and locomotives. The detailed study of economies, the detailed study of the character and efficiency of material purchased for a specific use, and the chemical and physical testing of same to see that the material is up to standard specifications, the necessity for reliable and economic supervision of these special features of modern industries causes an unending demand for the scientific man. Mr. Hoffhine's superior ability in all of these respects has unquestionably won his recent connection with the American Brake Shoe & Foundry Co.

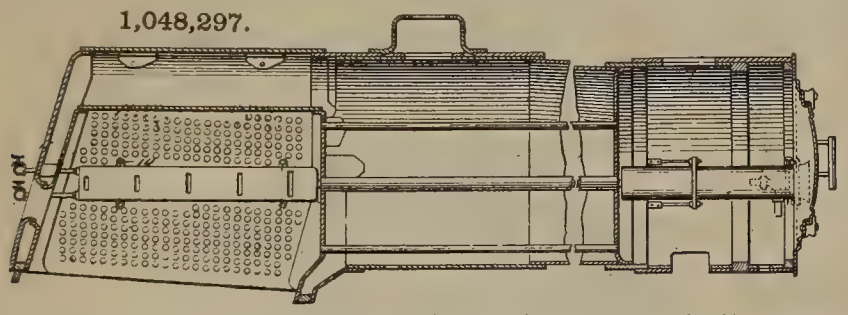
Recent Railway Mechanical Patents

SMOKE-CONSUMER.

1,048,297—Thomas Crawford, of Philadelphia, Assignor of Twenty-five One-hundredths to John M. James and Twenty-four One-hundredths to Henry M. Meason, of Philadelphia.

The object of this invention is to provide improved means whereby a supply of highly heated air is furnished to the fire box above the burning fuel, so as to render combustible the otherwise waste smoke and gases, and utilize to a maximum degree, the heat units in the fuel. A further object is to provide an air heating compartment located in the smoke box, and communicating with the outside air, said air chambers connected through flues of the boiler with air distributers in the fire box, whereby the air is

1,048,297.



highly heated in its chambers in the smoke box, and in its passage through the boiler and distributer before it passes into the smoke and gases, hence facilitating combustion.

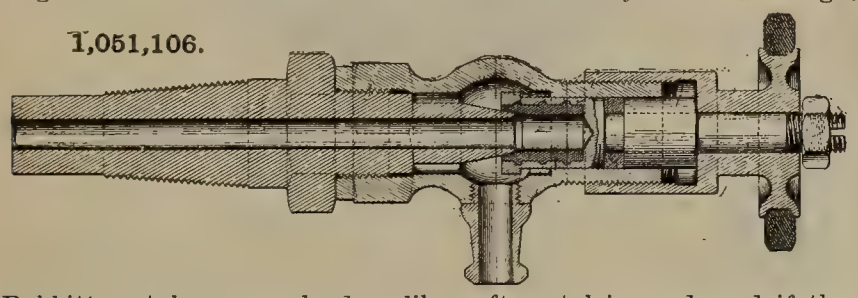
Another object is to provide improved means for water jacketing the air distributers in the fire box, and which means permit the disconnection of said water jackets with the water of the boiler to enable testing of the stay bolts without exerting pressure in the water jackets.

GAGE COCK.

1,051,106—Geo. J. Hatz, Omaha, Neb., Assignor of One-half to Charles E. Fuller, Omaha, Neb.

A most important feature of this gage cock is that in case the valve should leak, it can be ground without blowing the pressure off the boiler. This can be accomplished by first removing the nut from the end of the valve stem, then drawing the bonnet back just enough to slacken or loosen the valve from the seat, after which a screw driver or like implement can be inserted in the notch at the outer end of the valve stem and the valve can be rotated on its seat to effectively grind it. In practice, there will be found that there is enough grit or foreign matter in the water to grind the valve seat without the use of emery where a lining of

1,051,106.



Babbitt metal, copper, lead or like soft metal is used, and if there be any particle of scale under the seat, they can also be worked out in this manner.

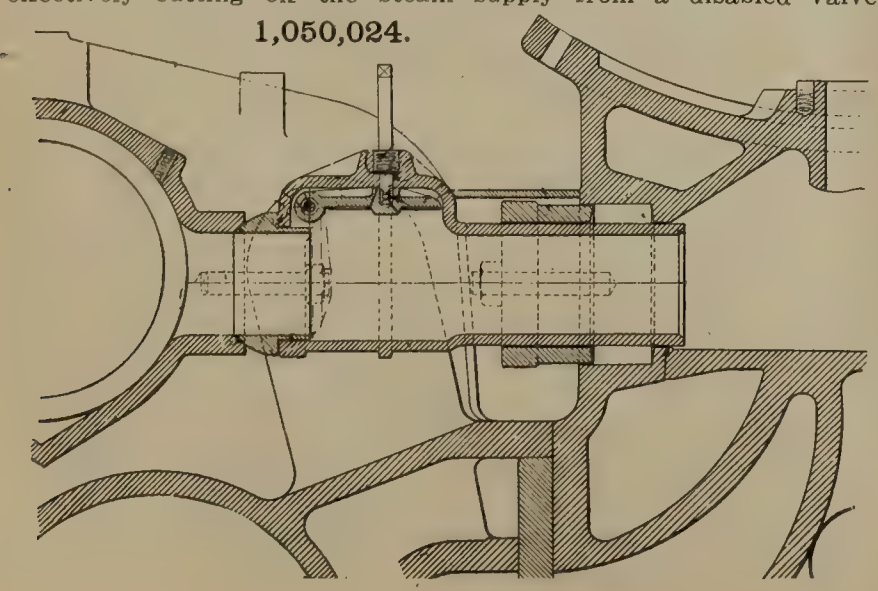
Inasmuch as the valve is provided at its inner end with a collar, it is impossible to remove the valve stem or valve without separating the main body of the gage cock from the plug or nipple which screws into the boiler. There is no way in which the valve may be removed, except by first separating the main body of the gage cock from the plug or nipple that screws into the boiler. The conoidal valve seat is made of such ample length that it can be readily ground or reamed off as wear occurs and without the necessity of renewing the plug or nipple of which it forms a part. In effect, the valve acts as a piston within the cylindrical outer portion of the body of the cock and the necessity for any further packing around the valve is avoided.

LOCOMOTIVE GATE-VALVE BETWEEN CYLINDER AND SADDLE.

1,050,024—Harry A. Hoke, Altoona, Pa.

This valve is adapted to provide simple and practical means for effectively cutting off the steam supply from a disabled valve

1,050,024.



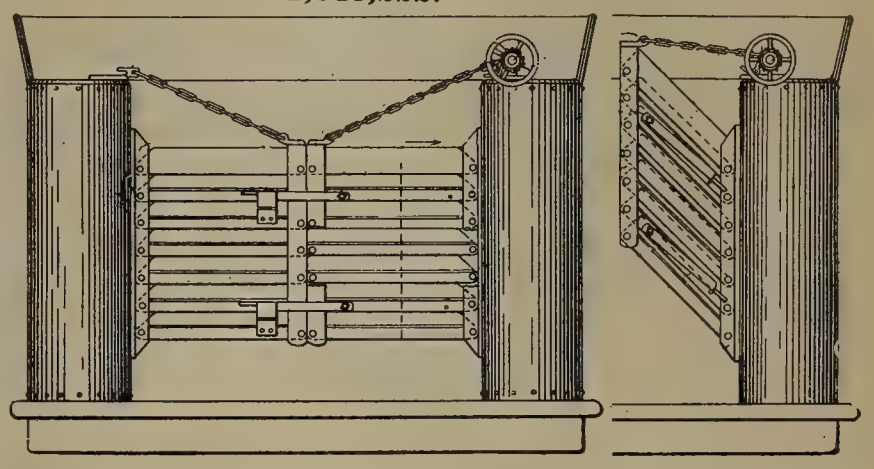
motion at one side of the locomotive, thus permitting the locomotive to be operated with one cylinder and one valve so that the engineer can proceed. The steam pipe is fitted with an improved gravity flap valve, the various parts being shown in cross section. This valve is normally held in an open position by a tap bolt, which engages a threaded opening in the boss located on the back of the valve. In order to provide for the free passage of live steam from the boiler to the cylinders, a recess is made in the top of the steam pipe, such that the valve when open will not retard the flow of live steam and interfere with the work of the locomotive.

TENDER COAL-GATE.

1,048,222—Milo A. Smith and Thomas J. Thornton, of Albion, Pa.

This invention may be operated by hand. Thus, by drawing upon chain the corresponding side of the gate may be raised and held in its raised attitude by slipping one of the links of chain

1,048,222.



over a hook or pin. Or, mechanical means may be provided for raising the portions of the gate. For example, the chain may be led to a winding shaft, turned by the hand-wheel and supplied with the ratchet and pawl. The bars are of angle irons placed close together and have an off-set flange affording a small space that permits a lower bar to move over the edge of a bar immediately above it, when the gate portions are raised. To effect the overlapping of the edges of the bars when raised, it will be noted that the pivotal points of the bars are near their lower edges.

JOURNAL-BOX.

1,046,032—Luther K. Smith, Moberly, Mo.

The object is to provide a journal box which shall be simple in construction and shall be economical and durable in use, and a most important object to be accomplished is that the parts mentioned which require adjustment and replacement in use may be so adjusted or replaced without dismantling a locomotive engine, if they are applied thereto, or sending the same to the repair shop, whereby usefulness of the engine is greatly increased. In achieving the foregoing objects, this invention consists in the production of means for taking up the wear between the journal bearing and the pedestal jaws comprising a wedge which can be adjusted to compensate for such wear without dismantling the engine, in combination with a liner and means for holding the latter against displacement.

1,046,032.

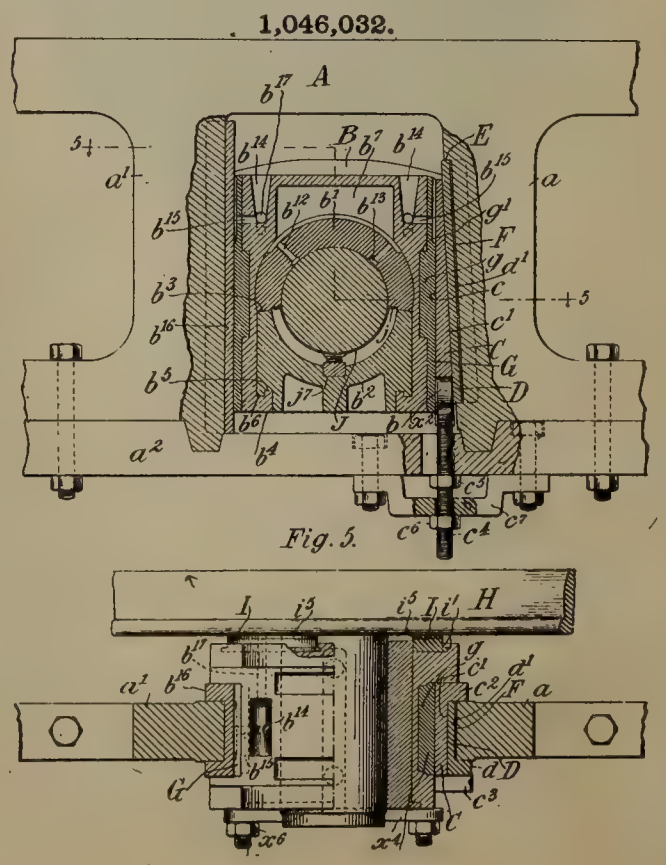


Fig. 5.

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Established 1878

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Vol. XXXVII Chicago, March, 1913 No. 3

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A NEW PHASE IN SAFETY WORK.

"Safety First." That slogan has a familiar sound now, but it is only a few years ago that it was unknown. We were familiar with the word "safety" then, but we didn't follow it up with "first." The "safety first" movement needs no defense; it is in effect on practically every large road in the country, and it is resulting in great good. It pays, not only from the humanitarian standpoint, but from the commercial standpoint.

Elsewhere in this issue we publish a paper on the "safety first" movement, recently delivered before the Western Railway Club by George Bradshaw, general safety agent of the New York Central Lines, which covers the subject very thoroughly. The illustrations tell a story in themselves and are evidence that Mr. Bradshaw and his associates are accomplishing things on the New York Central Lines. The attendance at the meeting at which this paper was delivered was pretty conclusive proof that railway men are enthusiastically interested in the work. The attendance was the largest at any meeting of the club held this year and the room was scarcely able to hold all who came. Among those present was R. C. Richards, general claim agent of the Chicago & North-Western, and the man who originally started the "safety first" movement. It was easy to understand how he had pushed it to a successful end on the North-Western, after listening to his talk. He was so full of earnestness and enthusiasm concerning the work that his hearers were instantly in sympathy with him. From his position in the claim department he has seen the dark and pitiful scenes which follow in the trail of accidents and of which the large majority have no conception. Probably every person who attended that meeting left it with a greater interest in safety work.

Mr. Bradshaw touched on a new phase in the work, namely, the necessity, in employing men, of giving more attention to their fitness to work alongside other men; of getting men that are fit mentally as well as physically. As he states, railway work is attractive and there is no reason why railways should not secure the pick of men. Too many roads use the "hire and fire" system. When times are dull the axe falls, and when there is a sudden increase in business the gates are opened and the first men in line get the jobs. The ideal method would be to maintain the same sized force the year around, but this is not entirely practicable. Nevertheless, much could be done to improve the present system and to minimize the fluctuations in forces. It is a paying investment to keep a man, who is known as a good man, on the payroll even at a slight loss. It saves breaking in a new man, which costs money; it gives a certain amount of elasticity to the force and it tends to create a spirit of loyalty which cannot be estimated in dollars and cents.

The statement of Mr. Bradshaw that the matter of employing men is not given enough importance is, we believe, justified. It is too often delegated to incompetent men and is done in a machine-like manner. The hiring of men does, and will continue to have, an important bearing on "safety first" work. Safeguards and rules will do much to decrease accidents, but the greatest thing in this work is to create in a man a sense of responsibility for the man working along-

side of him. This is the reason that more care should be exercised in hiring men; that a man's sense of moral responsibility should be taken into account as well as his skillfulness. It is for this reason that the suggestion that competent employment bureaus be organized in different cities is of especial interest. The higher officials cannot be expected to give much personal attention to employment work, but this work can be done by competent men, who will look up the records of applicants carefully and who will give encouragement to worthy men. Every applicant for a position should be given attention, and if worthy should be encouraged and kept in touch with, in order that when the time comes for increasing forces, there will be a source of supply.

THE PATENT PAGE.

The Patent Office Gazette to the casual reader is a very dry affair and yet perhaps it represents more thought than many other publications. It is issued weekly and contains a sketch and one or more of the claims for each patent issued during the current week. The number of patents published and granted each week ranges between six and seven hundred. Generally each one of these patents represents a great deal of thought and hard work on the part of somebody and the sketch and brief description may be the final result of years of work. Not always, of course, is this true. We have noticed patents granted for some locomotive devices for instance and have wondered if the author knew the difference between a locomotive and a corn shredder.

Most of the patents indicate, however, that the authors have a practical knowledge of the device they are seeking to improve, and it may be said that a large percentage are modifications or improvements of an existing device. The old saw about "nothing new under the sun" is well exemplified in the Patent Office Gazette. Some of the patents seem ludicrous, as for instance a number have been granted on devices for keeping the mouth closed, so that mouth-breathing during the night might be prevented. Occasionally while riding in a sleeper (riding, not sleeping, is the word) we have wished that we could apply just such devices to one or more persons in the immediate vicinity. The ideas which seem to appear most frequently in the organ of the Patent Office are patents on non-refillable bottles and on nut locks. We had thought that all the possible combinations on the nut lock proposition had been worked out, but we should judge that the average output is still about two a week.

It has been our custom to devote the last reader page of the *Railway Master Mechanic* to the publication of sketches and descriptions of a number of recent railway mechanical patents and we would like to emphasize the value of this page. The Patent Office Gazettes for the month previous, are carefully looked through and those devices which are of interest to railway mechanical men and which seem to have merit, are noted. Out of these, five or six of the best ones are published. It will be noted that most of the ones published have been granted to men holding responsible positions in the railway field. It is, of course, not possible to publish complete descriptions, but a complete copy of any patent may be obtained from the Commissioner of Patents for five cents. It is our purpose to have this page reflect the latest thought and development in things mechanical. It is usually a long step between the granting of a patent and placing it on the market, and as a matter of fact only a small percentage of those granted ever become of use and of profit. People have to be shown before they will adopt most new ideas and to bring an idea to a successful termination, takes preserverance and takes money. But never-the-less the patent page will bear watching and study. The ideas there shown are usually those of practical railway men who are striving to improve the methods used in the mechanical departments of our railways. The idea may be one which you have been working on and possibly not as good; it may be a device which is just suited to your particular needs. Moreover, it shows the trend of thought in this field and the efforts being made towards greater perfection and efficiency. The man who has been granted a patent is a thinking man. He is trying to do a thing better than the man before him has done it; he is endeavoring to add to man's efficiency, to increase our civilization. Patents mean progress.

TROUBLES WITH ELECTROLYSIS

Evidence of the pernicious effects of electrolysis has been discovered in the concrete incased steel structural members of train sheds and buildings in at least one electrically operated railway terminal. The situation is so alarming that expert electrical engineers have been engaged solely in inspection work in the hope of locating deteriorating parts in time to arrest the dangerously devasting results of electrolysis. In the meanwhile other men are constantly working to control all stray electric current by perfecting the bonding and return lead system.

This situation, while hardly one to be ordinarily expected, must be considered in electrification plans.

The use of large amounts of current under fairly heavy voltage calls for the greatest of care in its return to the power house. The problem, simple enough in open country, becomes most perplexing in the congested terminal located in the city practically living on electricity of a multiplicity of voltages and amperages.

In the case above mentioned the fact that even the spikes in the tracks were destroyed in a few months' time does not lend much to the danger of the situation, for it is the uncertainty with regard to the condition of the enclosed structural steel which worries the railway officers. Greater knowledge of ways and means of governing and controlling stray currents is imperatively needed by those responsible for large terminal electrification projects.

SAFETY FIRST SIGNS.

The "Safety First" bureau has become an established necessity on all of the larger systems. No longer an experiment in itself, the bureau now is, in a sense, one of experimentation. Its greatest and most important duty is that of educating both employees and the traveling public. Signs, mottoes and exhortations posted about railway property and in rolling stock are the results of the "safety first" bu-

reau's earliest efforts in this direction. These signs are of heterogeneous design and wording and to those most in need of their teaching, they mean nothing.

The transient foreign laborer and the ignorant traveler are most in need of the caution, lesson, or direction intended to be conveyed by the posted sign. The importance, therefore, of general standardization in this branch of effort is paramount. Considering, as an example, the most common and the most important of safety signs, "danger," or that next in importance "caution," the color scheme and wording should never vary, proportions should be kept the same no matter what the size. Red has long been regarded as a universal danger warning. This fact is due to its use by railways as a stop signal, since the beginning of their existence. A suggested universal standard danger sign is based upon the strongest color scheme known, black, red and white. A standardized arrangement of these colors could never be mistaken by the most ignorant, once translated. Permanency and resistance of defacement are also qualities to be insisted upon in standardization of signs. Enameled metal is generally considered as the best means of fulfilling these requirements. A system of inter-railway standards may be carried so far as to specify the locations for certain signs.

General economy and a better functioning of the "safety first" movement will result from consistent and co-operative study of this subject in all departments, with an early application of principles. Several state legislatures have considered bills covering this subject, and unless there is standardization in advance of legislation, the very ends coveted will be defeated through the variance of state laws.

AN EXPENSIVE AND ARBITRARY RULE.

One of the rules of the Interstate Commerce Commission covering the operation of locomotive boilers, calls for the drilling of staybolts for a distance of one and one-quarter inches from the outer sheet. Those experienced in boiler repairing know that the location of the fracture in a broken staybolt is invariably just inside of the sheet. A drilled hole an inch deep would, therefore, be fully as efficient a safeguard and the cost of compliance with the rule would be very greatly reduced. An embarrassment incident to the drilling of the deeper holes is the frequency with which the holes are accidentally carried out through the sides of the bolts, thus ruining the latter. It is very difficult to exactly center and direct the drills in this operation. It is owing to this feature that the custom of drilling staybolts before application is becoming general. To make this practice feasible it is, of course, necessary to apply the bolts from the inside of the firebox. A change in the rule in question calling for drilled holes one inch deep would simplify the process and decrease the incidental expense without detracting from the safety of the "tell-tale" feature in slightest degree.

THE LONDON, Brighton & South Coast railway, one of London, England's, suburban railways, which since 1909 has electrified some 70 miles of its suburban lines, has recently decided upon a further electrification to include, when completed, at least 170 miles of additional trackage. The work will be commenced as soon as the plans are completed and will extend over four years. The lines to be transformed will be divided into sections and the work will be proceeded with accordingly. This road is using the single-phase, overhead, alternating-current system.

IN THE SAGINAW SHOPS OF THE PERE MARQUETTE, scrap radial staybolt iron is reused in short staybolts after an annealing process. This is an idea developed by S. A. Chamberlin, master mechanic at that point. It has been found that by throwing into the oil furnaces at quitting time, the scrap radial stays taken out during the day, a large quantity of perfectly annealed short staybolt iron is available next day. Test pieces of this annealed iron will bend double while cold without fracture.

AUTOMATIC TRAIN STOPS in which electrical apparatus on the roadway acts upon electrical apparatus on the train by means of electromagnetic induction, continue to offer promise of success according to a recent report of the Block Signal-Train Control Board.

RAILROAD MEETING OF A. S. M. E.

The railway committee of the American Society of Mechanical Engineers has arranged for the discussion of the subject of steel passenger car design in its various phases at a meeting to be held in the Engineering Societies Building, 29 W. 39th St., New York City, on the evening of April 8.

The first session, under the direction of this committee, was held at the annual meeting of the society in December and considered the factors involved in the selection of locomotives and train lighting. It proved so successful that it was decided to hold a second session, as announced above.

The following parties have already accepted an invitation to discuss the various phases of the subject: Steel Car Design, W. F. Kiesel, Jr., assistant mechanical engineer Pennsylvania R. R.; Suspension of Steel Cars, E. W. Summers, president, Summers Steel Car Company; Trucks for Steel Passenger Cars, J. A. Pilcher, mechanical engineer, Norfolk & Western Ry.; Provision for Electric Lighting in Steel Cars, H. A. Currie, assistant electrical engineer, N. Y. C. & H. R.; Provision for Electrical Equipment on Steel Motor Cars, F. W. Butt, assistant engineer, N. Y. C. & H. R.; Special Ends for Steel Passenger Cars, H. M. Estabrook, president, Barney & Smith Car Company; Draft Gears for Steel Passenger Cars, S. P. Bush, Buckeye Steel Castings Company; Cast Steel Double Body Bolster and End Frames for Steel Cars, C. T. Westlake, chief mechanical engineer, Commonwealth Steel Company.

Other subjects which will be discussed are as follows; the names of those to whom they have been assigned will be announced later:—Introduction to General Discussion of Steel Passenger Cars; Superstructure of Steel Cars; Roof Structure for Steel Cars; Interior Steel Finish for Steel Passenge Cars; Corrosion and Protection of Steel Passenger Cars; Air Brakes for Heavy Steel Passenger Cars and Special Pressed Steel Shapes for Steel Cars.

This is the first time that there has even been a general meeting of engineers for the discussion of this problem and it is the intention to bring out the very latest developments in the various features of steel paseenger car design.

The chairman of the railway committee is E. B. Katte, chief engineer, electric traction, N. Y. C. & H. R., Grand Central Station, New York, N. Y.

THE TREND OF SHOP WORK.

When, some little time back, it filtered out to this country that a new science had arisen in Europe and was baptized "Motion Study," we were not prepared to be told so soon that it has already established itself firmly in America, and that some large establishments were already being run on its principles; indeed that its principles were being made only a basis for a system called "scientific management" under which shop working proceeds absolutely on the lines of a marionette show where each actual worker becomes a wooden automaton worked by so many strings—only unlike the marionette of our childhood in this respect, that instead of the strings being manipulated by a single *deus ex machina,* each is pulled by a separate tormentor. We have been long prepared for some spread in the practice of specialism—an almost inevitable result of the accumulation of detailed and minute information on subjects which, but a few years ago, were known only in a general way. But specialization in a complete wide branch of a subject is a different thing to specialization in one or two mechanical operations, which after all is what the poor worker in the new system is reduced to because, forsooth, he has been trained to perform these few operations well and quickly, and consequently saves his employer money. It is true he, too, gets some more pay as a so-called specialist, but he earns it at a sacrifice of the general education and interest that attend some variety in employment, some occupation that calls for thinking and individuality. Scientific management begins with studying the worker's motions by means of a stop watch, and training him to eliminate all unnecessary ones till he has habituated himself to doing a certain task in the most direct way, and consequently in the least possible time. Simultaneously appliances are altered or re-designed to better suit the improved motions with which the task is performed. And thus a sort of reduced time-table is arrived at which becomes the standard to which the man must work in future; and following this comes an organization for supplying the required materials and the required "further instructions" from above at the correct time. And thus, it is claimed, the properly trained human machine is made to turn out twice, sometimes thrice, the ordinary amount of work in a stated time, for which he receives not twice the ordinary wages, but something more only by way of encouragement, the balance of profit being divided between his employer and the geniuses that have trained him. If he fails to come up to expectations he is dismissed or relegated to some extremely humble duty not worthy of being brought under the dignity of scientific management. Apparently no allowance is made for a day when the man may be under *par* for some reason, perhaps after a sleepless night, or in consequence of a bad head, or when disturbed by some mental trouble, when the whole working may get out of gear and confusion extend to other units in the shop. It seems to us akin to running a train for 1,000 miles, scheduled at the top speed of the engine, with junctions at every 50 miles; and to expect that train to arrive at its destination punctually every day. But admitting that the system has fair success in a certain number of cases, it is difficult to see how it is going to be established in old shops containing workmen who have for years worked and attained proficiency, each in his own way. Is it likely that these men will successfully acquire the science of motion study, and if they do not are they to be replaced by youths to whom the acquisition might be comparatively easy? The proper application of this kind of scientific management involves, as we have said, prolonged motion study, a re-arrangement of machinery in a shop, a planning organization at the top and an intermediate organization whose duty it will be to arrange the machinery and the various operations so that the brain work of the designer will be turned out by the hand of the automaton without let or hindrance—a task we do not envy the intermediary. He has to issue clear written instructions of the most detailed kind to be followed slavishly, and must overlook nothing lest he throw the whole shop out of gear. The workman, on the other hand, must without question carry out these instructions to the letter, although in the very act of doing so he might see a better way for their accomplishment, which neither he nor his instructor will care to discuss for fear of wasting the precious time that has so scientifically been parcelled out. In the face of it this does not seem like efficiency in its broadest sense, but more like a wilful waste of human intelligence. It is a reversion to the old times when the theory was held that a soldier on a battle field was no more than a pawn, that he need not possess intelligence, or education, or initiative, so long as he blindly obeyed the directions of his officer. This is a theory which has been given up in recent years, and we are surprised to find it making its way once again into the industrial world. Its advocates say that it is already in successful operation; but we think we have heard before of successes with fads which have not stood the strain of continued pressure, and have melted away when the enthusiasm that heralded their inception has waned.—*Indian Engineering,* Calcutta.

A LIST of the conventions covering the various organizations in the railway mechanical field is published on another page. We publish the location and date of the next annual convention together with the subjects to be covered at those conventions. A study of these subjects will prove very interesting, showing, as it does, the trend of railway thought and discussion during the present year. We also give the name and address of the secretary of each association. It would be to the advantage of any railway man not connected with one of these associations to get in touch with one or more of them.

THE PANAMA EXPOSITION at San Francisco in 1915 will contain an exhibit by the Santa Fe costing over $200,000, and covering five acres of land. The feature will be a mammoth reproduction of the Grand Canon of Arizona which will be developed by models and paintings, showing over fifty miles of the canon. There will also be Indian villages and at the entrance a building constructed in mission style, housing the Harvey collection.

THE "LAND OF HEART'S DESIRE" can't be reached with muddy feet—the roads are clean only for those who climb cleanly. Real success isn't the attainment of money or of fame, but the attainment of self respect—the one thing in the world that's worth most and one of the few things that can't be bought, but only sold.—Forrest Crissey, in *Chicago Tribune.*

WM. HALL, SECRETARY of the International Railway General Foremen's Association has moved from Escanaba, Mich., to 829 W. Broadway, Winona, Minn.

The Chicago, Burlington & Quincy has let contract to Twohy Bros. Co., Portland, Ore., for the construction of the new line to be built between Powder River, Wyo., and the Colorado & Southern Ry. at Orin Junction, Wyo., about 140 miles. This extension will involve a total expense of about $6,500,000 and the greater part of a year will be required to complete the work. The line will parallel the Chicago & North Western for the entire distance.

The Safety First Movement

By George Bradshaw, General Safety Agent, New York Central Lines.*

Within the memory of men still living the first railroad spike was driven in America. In this brief period the railroads of our country, both in extent of mileage and in efficiency of operation, have become the wonder and the admiration of the world. Indeed, the history of American railroads is the history of the talent and toil systematically and persistently applied to material problems which have achieved results unparalleled in the annals of mankind.

Proud as we justly are of these results, candor compels the admission that they have been attained at too great cost of life and limb. Realizing this fact, many railroads have recently put into effect organizations for the prevention of injuries. These organizations constitute what is commonly known as the "Safety First" movement, the inauguration of which may seem logically to imply that prior to its inauguration safety was not of first consideration in railroad operation. In answer to this, it may be said that railroad officials are moulded of the same clay as other men—neither better nor worse than the general type of successful men of affairs. They have not been indifferent to the sacredness of human life, but in the conduct of their business, according to accepted standards, they have, because of the very nature and magnitude of that business, been conspicuous in the matter of personal injuries, for the same reason, they have been conspicuous in other matters. They have always realized and regretted—to the same extent and no more than people generally realized and regretted—the loss of life and limb incident to their business and they have thought—just as the public generally has thought—that such loss, or at least the greater part of it, was a necessary result of success in railroad operation.

The "Safety First" idea has shown, or perhaps I should say is showing, railroad men, as it is showing others, that such loss is not a necessary result, and railroad officials have not been slow to put the idea into effect. There are two truths which it has always been difficult to discover—the truth hidden in complication or mystery and the truth so plain and commonplace that every one sees it. The principles of the "Safety First" movement belong to the latter class. They were so simple, plain, and practicable that it took a long time to discover them. Railroad men have always known that unsafe conditions and practices should be corrected, but the problem has been to find an effective way of correcting them and keeping them corrected. The public have been trying to find a way of doing this apparently simple thing for the last thirty years by the enactment of laws prescribing various safety devices and methods of operation, until today the car repairer and the boiler maker need an opinion from the law department before replacing a broken drawbar, or caulking a flue. Yet, every year the personal injury record among employes has been growing worse. The doctor has been giving us the wrong medicine.

It has been remarked that the Interstate Commerce Commission, in a recent report, states that accidents are caused by "human error, the personal equation, and a general hopeless, pessimistic attitude." It's a pity we didn't know that before. Think of the many many injuries and deaths which could have been prevented if every track and shop foreman had been required every morning before letting their men go to work to search them for "human error, personal equation and a general hopeless, pessimistic attitude." Now, that we know the truth, we ought to discharge on the spot any employe who reports for duty with such weapons on his person. No wonder we have had accidents with employes carrying around those infernal machines.

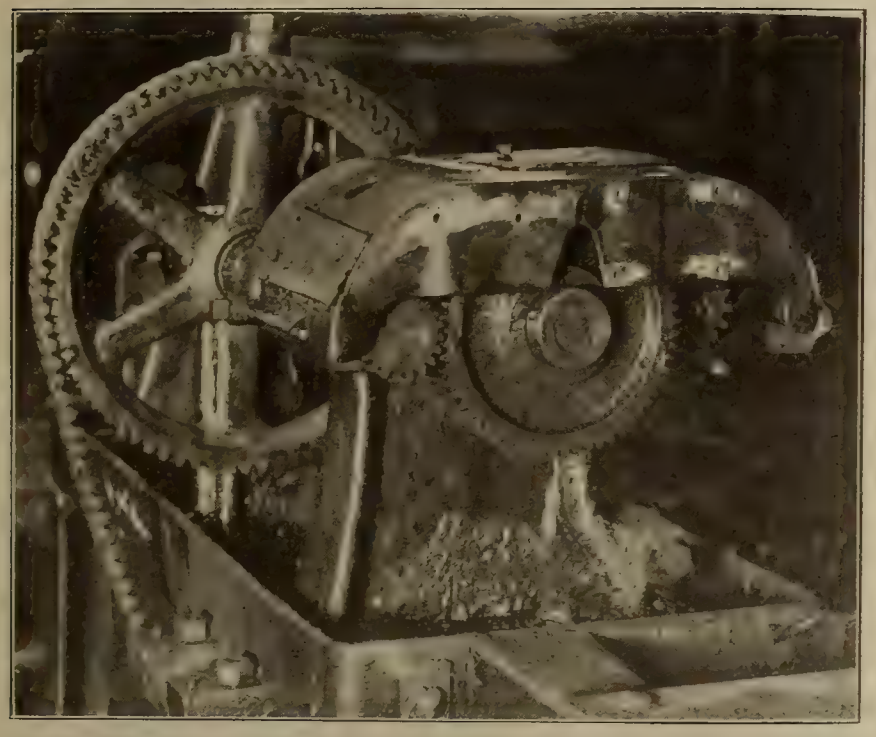


Fig. 1—Guard Covering Only Upper Part of Gears, Leaving Lower Portion Exposed. An Employe was Caught and Injured by Exposed Portion of Gears, which Have Since Been Entirely Inclosed.

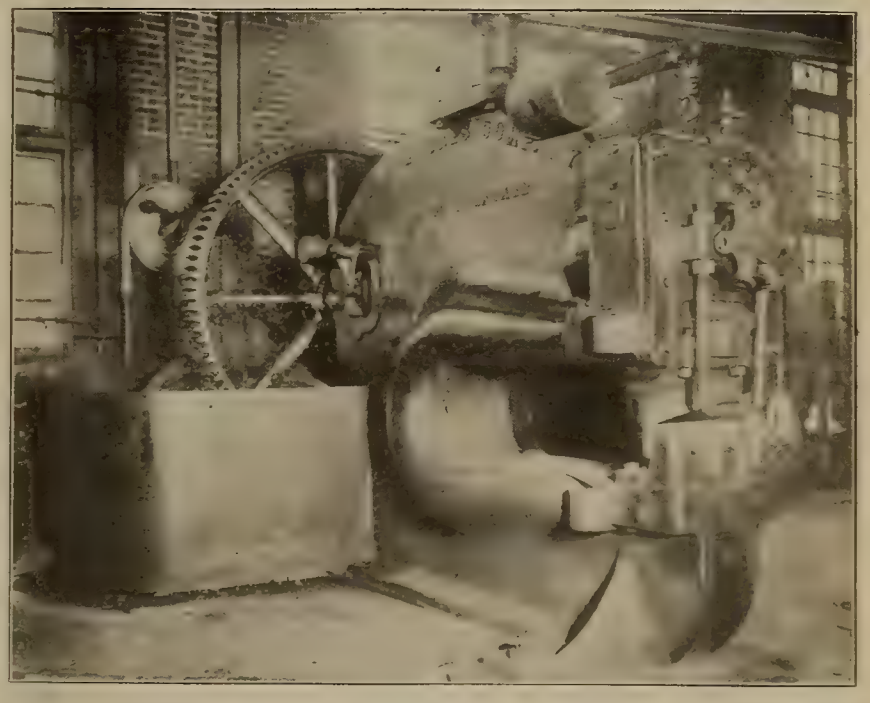


Fig. 2—Shears Incompletely Guarded. A Man Might be Caught in the Large Gear or Might Get Ends of Material Such as Pipes or Rods Caught in the Spokes.

The theory of the Interstate Commerce Commission for the prevention of accidents is to have a uniform system of reporting them.

After years and years of criticising and theorizing, of harmonizing and sermonizing, we are just beginning in fact, to prevent injuries and it remained for railroad men themselves to put into effect the plan for doing it.

The "Safety First" movement is simply a method for getting results which we have been unable to get, to the desired extent, by means of laws, rules and regulations. While

*A paper delivered before the Western Railway Club on February 18, 1913.

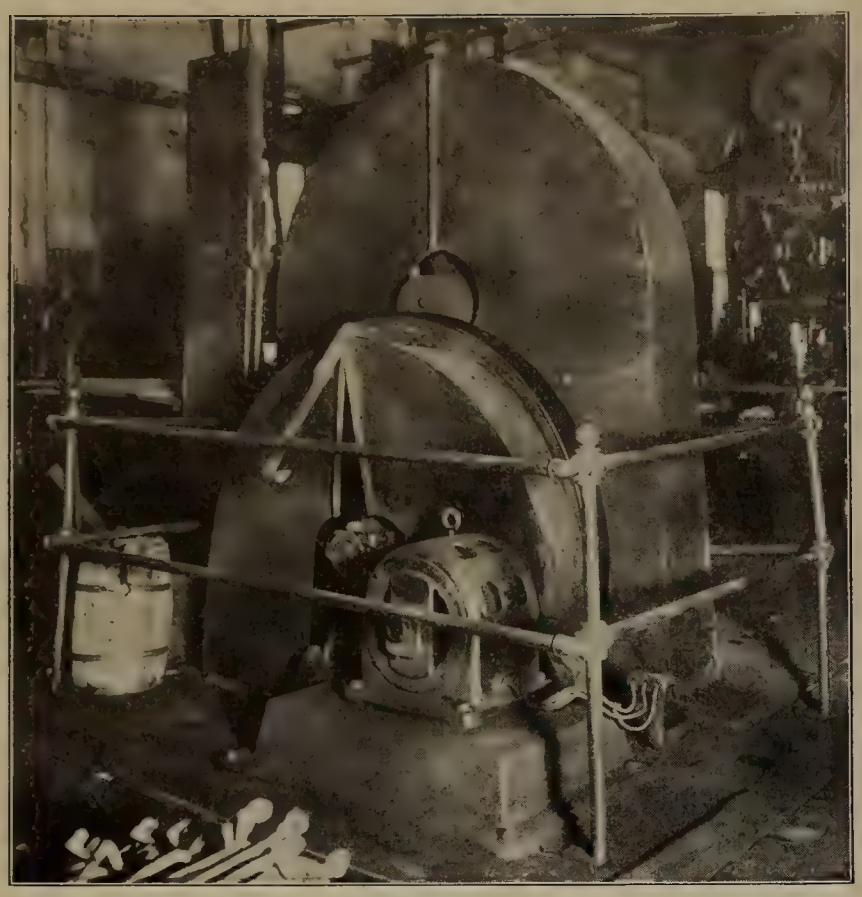


Fig. 3—An Adequate but Unnecessarily Expensive Guard. The Pipe Railing Serves no Useful Purpose and Woven Wire Would Have Been Cheaper and Preferable.

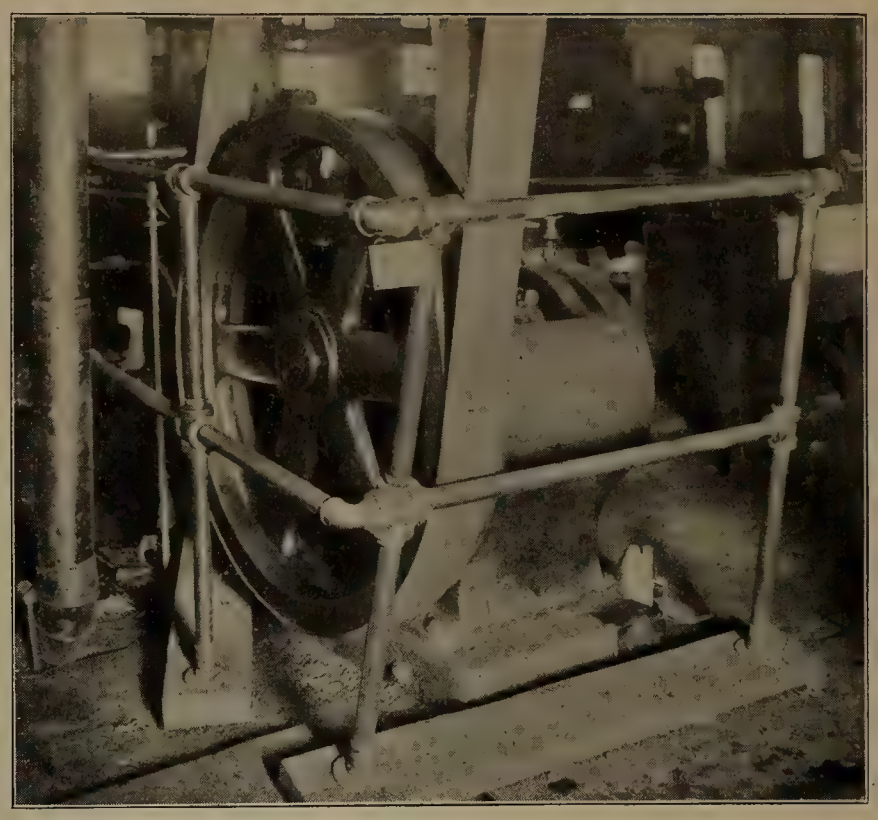


Fig. 4—This Pipe Railing Does not Afford Ample Protection, as The Movable Parts are not Sufficiently Inclosed.

of course every official is supposed to and does give attention to the more apparent safety precautions in his own department, there are so many matters relating solely to safety—matters which do not effect efficiency one way or the other—that there is need, on every large road, of a safety organization. In the absence of such organization on a large road, safety, except so far as it pertains to the operation of trains, is apt to be more or less an incidental consideration. Now, that may seem a strong statement, but I think I can show you it is justified. The head of every department of a railroad ordinarily has as much work as he can do—sometimes more than he can do. Being human, he and the men under him do first and do best that which they are most pressed to do, and they are most pressed in matters relating to efficiency. For example:

What superintendent of motive power is able, or should be expected to be able, in connection with his regular duties, to give serious attention to the safe guarding of machinery? Perhaps some may think this simply a detail to be attended to as an incidental consideration. It is in fact a detail, but an important one; and because it is a detail, it is neglected unless assigned to some one as a part of his duties.

In all things material, our railroads are marvels of system and efficiency. The car accountant can give you the number, description, and dimensions of every car passing every station on his line for years past. Every piece of freight, from a coffee pot to a threshing machine, as it moves over the line, transcribes a record showing the date, hour and place of its movement, as accurately as the dial on the cage shows the position of the elevator. The car department can tell you the kind and cost of every bolt, beam and brace, in every car repaired. Every engine failure, every leaky flue, every side rod broken, every crown sheet dropped, every drawbar pulled out, every car derailed, every hand car damaged, every minute "over time" by every crew—all these are matters for prompt report and careful investigation—as they should be—by competent men charged with the duty of investigation and prevention. But when an accident happens—one of the ordinary every day accidents which

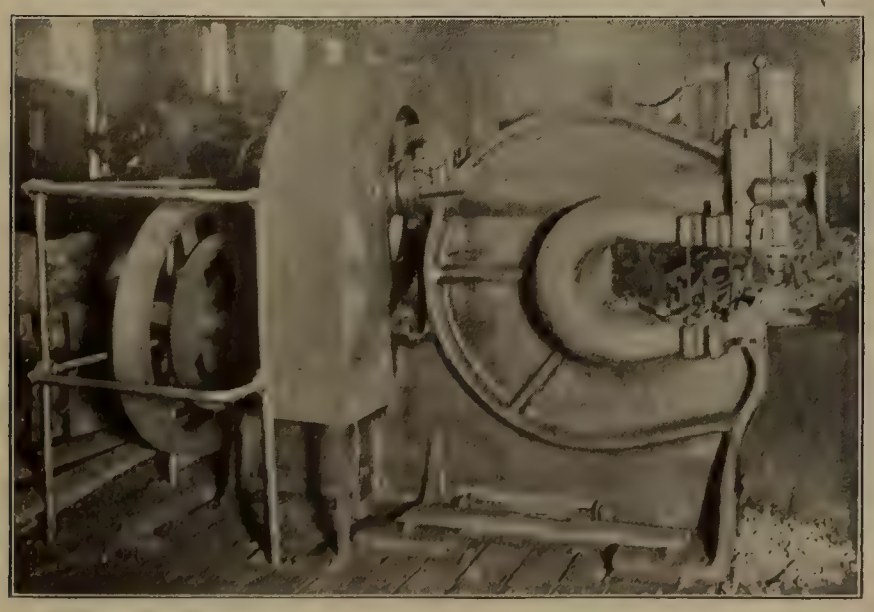


Fig. 5—Punch Guarded by Pipe Railing and Sheet Metal. Open to the Same Objections as the Guards in Figures 3 and 4.

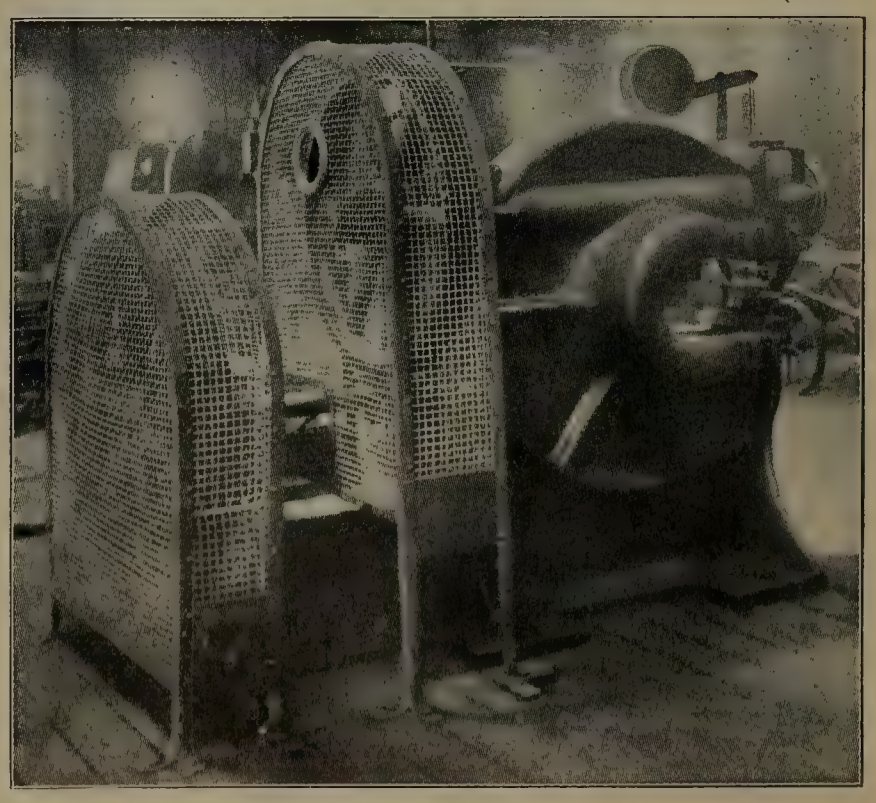


Fig. 6—Machine Shown in Fig. 5, Guarded with Woven Wire.

make the big total at the end of the year—there is, in the absence of a safety organization, as a rule, no one charged specifically with the duty of investigation with a view of discovering and applying a remedy. Or, if a remedy should be applied in the locality of the accident, there is no one whose particular duty it is to follow up and make the remedy one of general application.

This condition of affairs which so recently prevailed on practically all roads, and which perhaps today exists on some roads, has been and is being fast changed by the progress of "Safety First." Safety committees composed of officers and employes—whose duties are to discover and correct unsafe conditions and practices—now exist on almost 200,000 miles of railroad in the United States. The man who first conceived the idea of safety committees on railroads is R. C. Richards general claim agent of the Chicago & North-Western, and his company was the first railroad to put the idea into effect. The most difficult thing in the world to find is a new thought,. Of the millions of men upon the earth and of the greater number of millions beneath its surface, but few indeed, perhaps not one in a million, have ever added one truly new thought to the world's storehouse of knowledge, Mr. Richards belongs to that small class of great men who have originated ideas: and in future years railroad men the country over will honor him for the service he has rendered.

The New York Central took up safety work as a distinct branch of the service about two and a half years ago. It now has sixty division and shop committees comprising about nine hundred members, over a territory of about 12,000 miles. In addition to this force, the general safety agent and nine employes are assigned to the work.

I can perhaps best convey my ideas as to the proper conduct of a safety organization by stating what is being done on the New York Central. We do not claim to have attained anything like the ideal. In fact any success which we may have been able to achieve has been due in a great measure to valuable information and advise from gentlemen engaged in this line of work for other companies. However, an account of what we have done and are trying to do may at least serve the useful purpose of showing how are theories worked out in practice and perhaps enable you to derive some benefit by learning something that you should or should not do.

We began this work in the shops, where attention was chiefly directed to the guarding of machines. I wish to speak somewhat in detail on the subject of "Shop Safeguards" because, in my opinion, this is an important branch of the subject, and for the further reason that many members of this club, I understand, represent mechanical departments. It may seem to some that the construction of a safeguard is a simple matter. However, on the New York Central we have found this to be a subject requiring much study, and in association with officials of the motive power and car departments, we have been giving the matter serious attention for some considerable time, in order to ascertain:

1. The kind of machines and conditions requiring safeguards.
2. The proper material for their construction.
3. The best material for their construction.

It is an easy matter to apply some kind, or any kind, of a safeguard here and there, but to do the work properly, economically and systematically is quite another thing. In the first place, only those machines and conditions should be guarded which need guarding and they should be guarded in an effective and practical manner and at a minimum expenditure of labor and material. To do this is by no means an easy task. It requires, first, general knowledge of machine operation, and, secondly, familiarity with personal injury records covering varied and extensive conditions. The second requirement is as essential as the first. Men regularly employed about machinery may be unaware of many hazardous conditions with which they are daily confronted. There is a tendency to consider their own plant as a unit and to conclude that a certain condition is safe, because, to their knowledge, no injury has been due to that particular condition in that particular plant.

In making general inspections of shops, I have had a certain machine or condition called to my attention as needing a safeguard. In another shop, I have been assured by men equally as capable, that a similar machine or condition needed no safeguard. The reason was that in the first shop, that particular machine or condition had caused an injury, while in the second, it had not done so. Of course, there are many conditions in the average shop which, to an ordinary observer, are plainly hazardous and many others which are plainly safe; but between the two extremes there is a multitude of conditions, which it may be necessary or unnecessary to guard, according to the personal injury record of those conditions, not in any one shop or in one collection of shops, but in a large system of shops. That a condition, presenting a probable cause of injury, should not be guarded because the same has not in fact resulted in injury, is an argument no more sound than that we should not insure a building because it has never been damaged by fire.

The proper time and place to guard a machine is when the machine is being built and the man who should guard it is the man who made it. Our factory laws permit manufacturers to construct and distribute machines without giv-

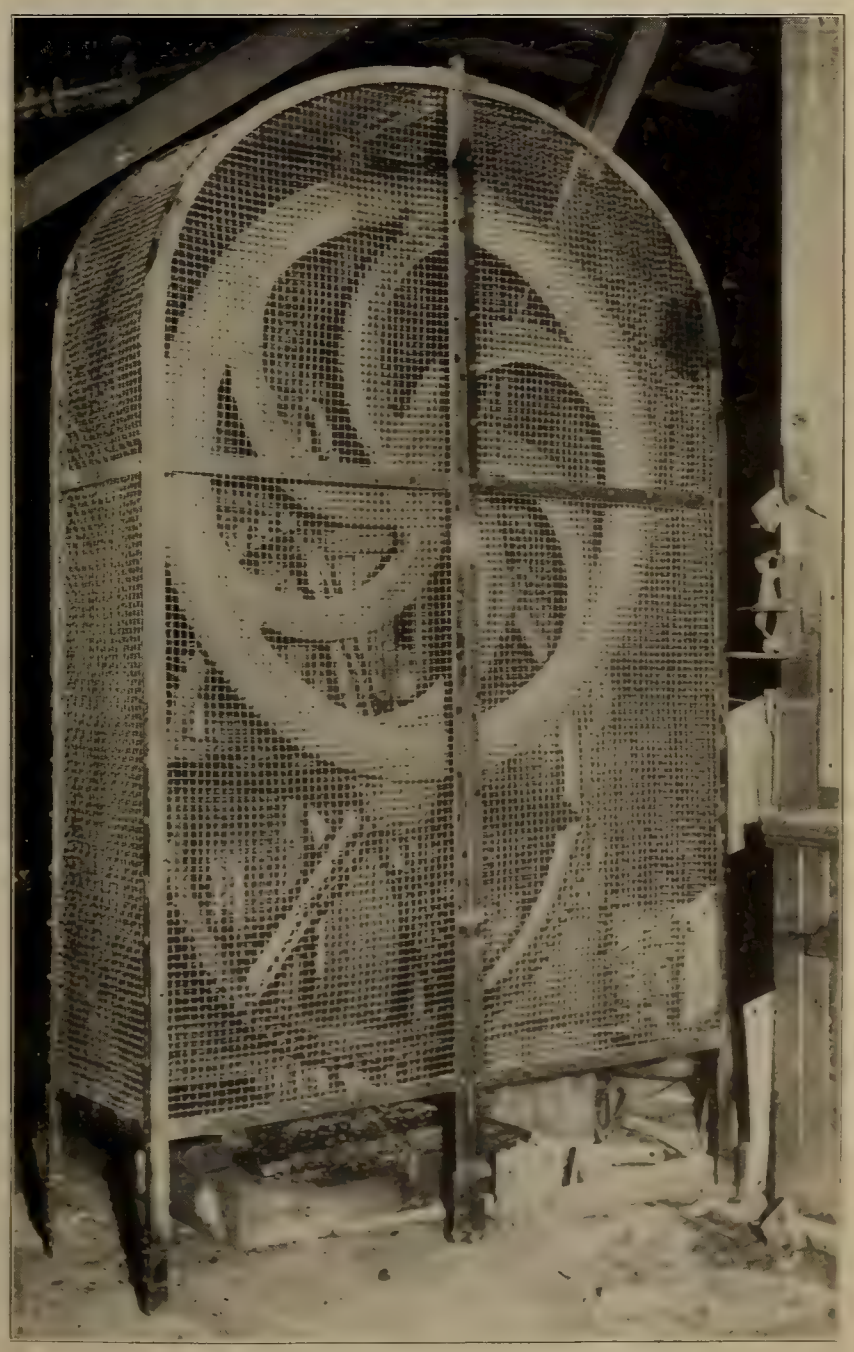


Fig. 7—Typical Woven Wire Guard.

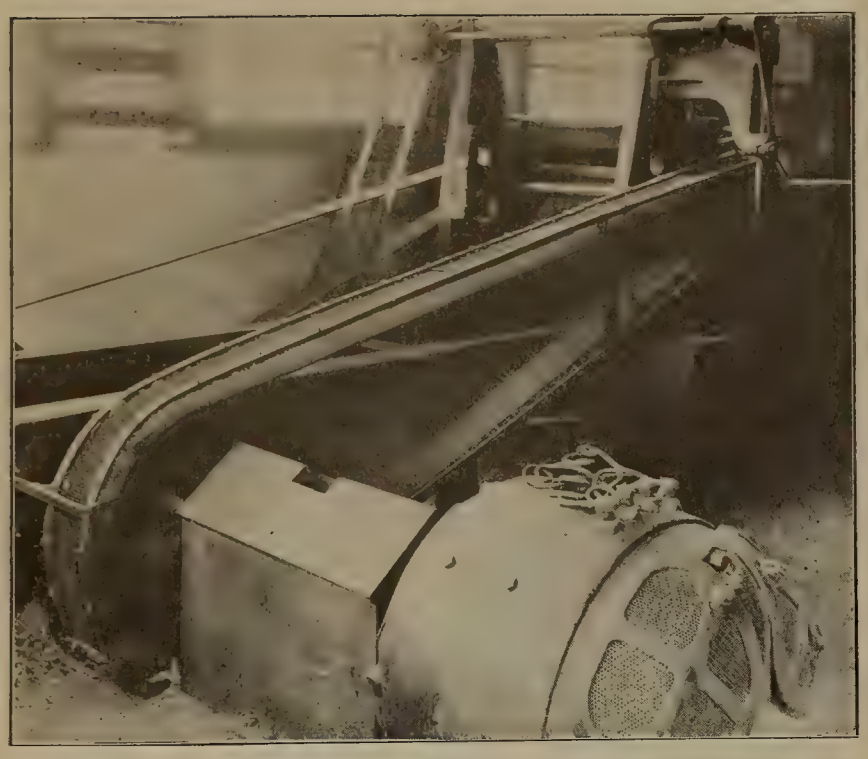


Fig. 8—Woven Wire Belt Guard.

ing any consideration whatever to safeguards and then after machines have been distributed all over the country and perhaps put into use without safeguards, inspectors are employed to ferret the machines out and have them guarded at the expense of the users. A much easier and more effective way would be to require the manufacturers to supply the guards in the first place. Until such laws are enacted, railroads, in ordering machinery, should stipulate that the same shall be guarded according to proper specifications. Even if all machines were as adequately guarded as possible, by manufacturers, there would still remain the necessity for guards for many shop conditions which can only be constructed and applied in shops.

Materials ordinarily used in the construction of safeguards are wood, woven wire, pipe railing and sheet metal, all of which are adaptable for particular purposes.

Wood is proper for covers, walk-ways and railings, but

Fig. 10—Belt Guards.

generally speaking should not be applied to machines or used to enclose parts of machines.

Pipe railing may be used in front of switchboards, about pits, and around fly-wheels and pulleys in engine rooms where only those in charge have occasion to go. It should not be used for guarding fly-wheels and pulleys in shops.

Woven wire is preferable for fly-wheels, pulleys and large gears because it allows free circulation of light and air and permits a view at all times of movable parts of machine which may enable the operator to observe a defect or improper condition before it results in a breakdown of machine. It is also more easily and cheaply applied than heavy sheet metal. Wire not less than one-eighth inch diameter with mesh not greater than one inch should be used. Smoke stack netting or expanded metal serves the purpose.

The proper construction of safeguards requires:

1. They must not interfere with the operation of machine or inconvenience the operator.
2. They should, as far as possible, be automatic so that their efficiency does not depend upon their being properly adjusted or upon any other "human element."
3. They should be of strong material, firmly attached and applied as closely as permissible to the part of the machine to be protected.
4. Ordinarily a space of not less than six inches should be left between guard and floor to permit sweeping beneath guard.
5. They should be attached to the machine, floor, or other support so that they cannot be set aside, doors or slides closing automatically being provided where necessary.

It is seldom advisable to purchase patent safeguards because a large percentage of such safeguards are not

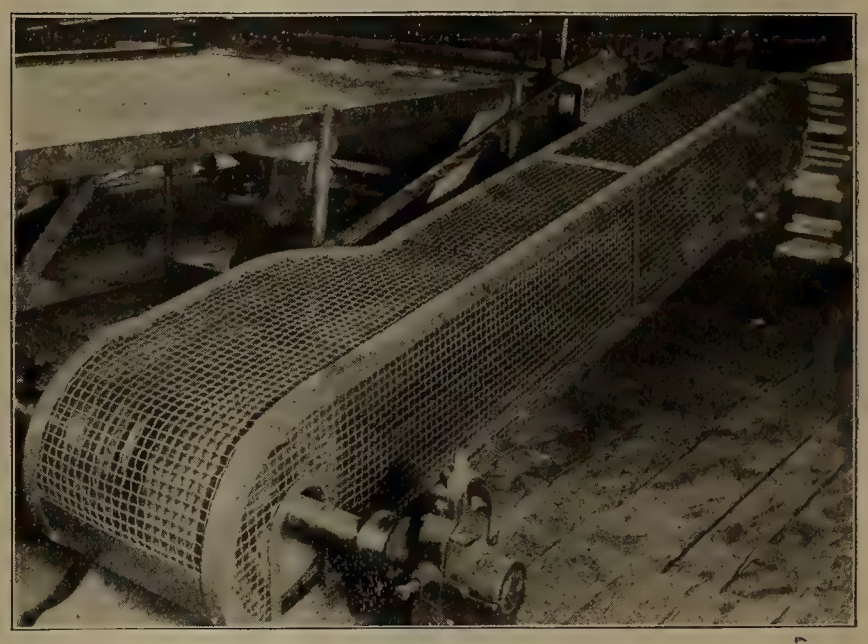


Fig. 9.—Woven Wire Belt Guard.

practicable. In almost every shop there is considerable scrap material which may be used to good advantage in the construction of guards and the very fact that guards are being made and applied in the shop is in itself an object lesson in safety, which would not be gained by applying patent safeguards.

As a result of investigation and study given the subject of safeguards, we have prepared and put into effect, standard specifications for safety devices. These specifications, illustrated by photographs and drawings, are printed in portfolio form and distributed to all officials have anything to do with machinery. These specifications have been developed as a result of experience in the construction of safe-

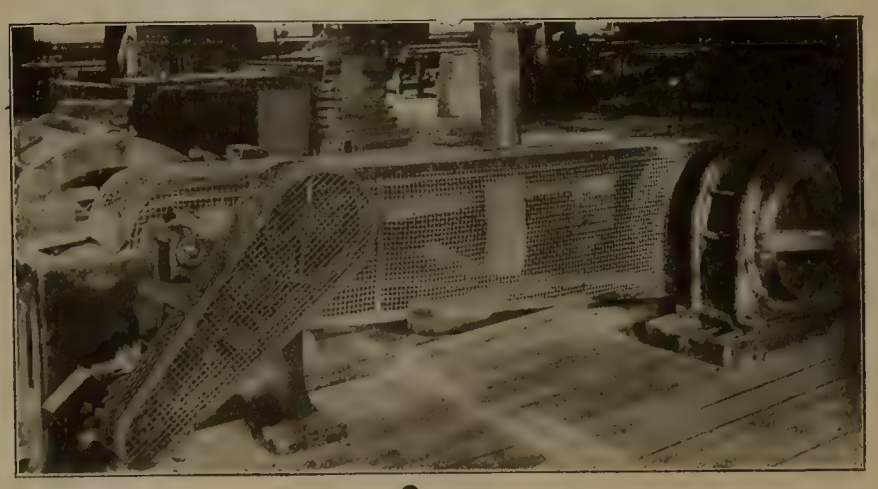


Fig. 11—Typical Belt Guard.

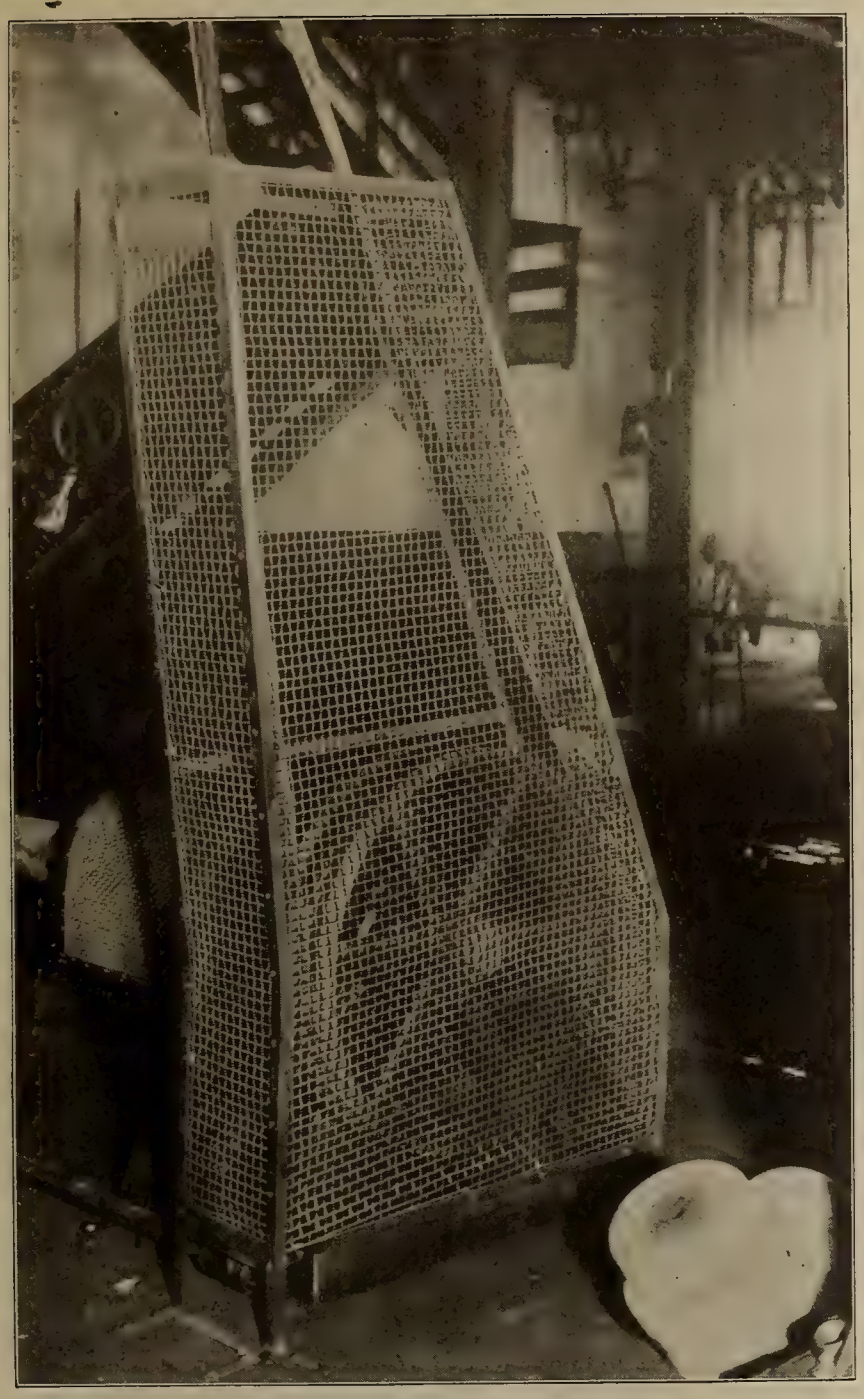


Fig. 12—Vertical Belt Guard.

guards for many machines in various shops during the last three years. Many guards applied when this work was first begun, we have found as the result of further study to be not fully protective, unnecessarily expensive, or otherwise objectionable. We have, therefore, taken those guards which experience has shown to be the most effective, practicable and economical and made them standard for all shops. It is not, therefore, left to those in charge of any particular shop, whose experience is necessarily more or less limited, to decide what machines shall be guarded. We are guarding all of them, the nature of which, as shown from the history of the machine in all the shops, makes the application of guards necessary, and the same machine is guarded in the same manner and with the same material in all shops. The illustrations herewith tell their story very plainly. Figures 1 to 5 show some improperly constructed safeguards. Figures 6 to 13 show some safeguards constructed according to standard specifications as prescribed for the New York Central lines. The number, kind, color and quality of lenses in the eye guard illustrated in figure 13, were determined by tests and experience.

Perhaps four-fifths of the conditions corrected by safety committees are those which might be considered of a minor nature, that is, such conditions as are seen almost every day and which because of their common occurrence would be to a considerable extent overlooked except for the attention given to such matters by members of these committees. In other words, the conditions corrected by safety

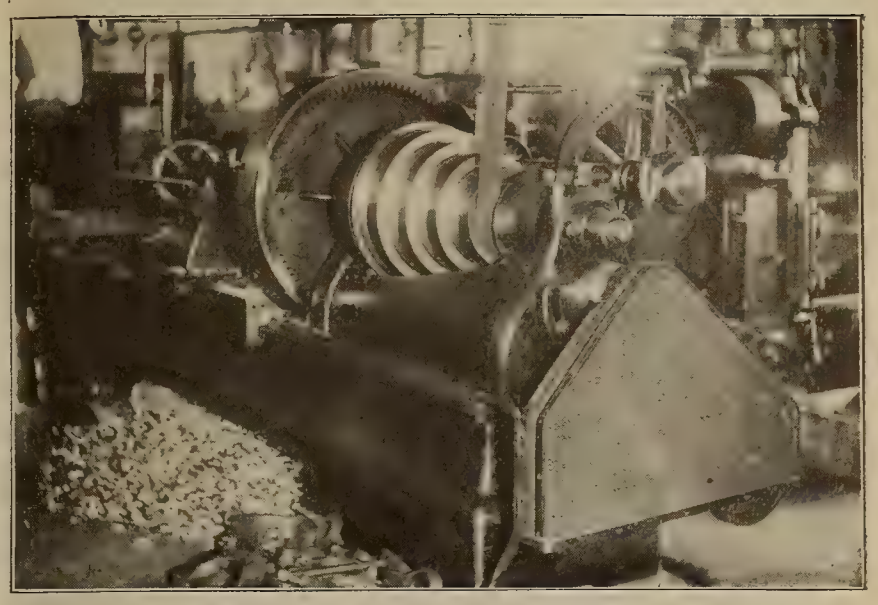


Fig. 13—Woven Wire Guard for Gears.

committees do not, as a rule, involve a great deal of expense. The correction of such conditions, however, is important, in fact sometimes more important than conditions which by reason of their prominence or infrequency attract special attention.

I call your attention to a few conditions often responsible for injuries which are found with more or less frequency on all roads, and which are being corrected by the action of safety committees. These are shown in figures 14 to 19.

It is a fact, however, that unsafe conditions are not responsible for the greater number of preventable injuries—at least not on the New York Central. For the last two years, we have been making, each month, a classification of injuries according to causes. This record shows that from sixty to seventy per cent of the accidents which could have been avoided were due to unsafe practices on the part of employes.

Fig. 14—Eye Guard Used in Electric Welding.

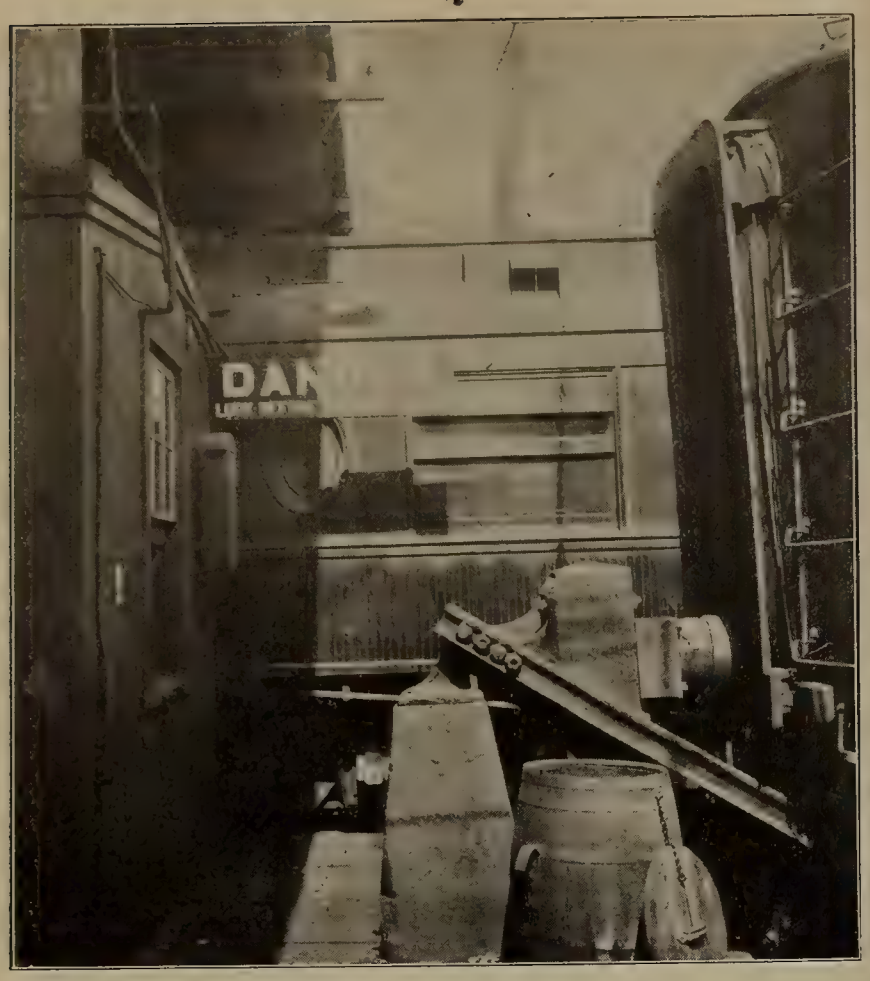


Fig. 15—Bumping Post About 4 Feet from Building Occupied by Employes.

In order to make fully effective the efforts of railroad officials for greater safety, there must be among employes an improvement in the "human element." It is not enough that railroad employes should be as reliable and faithful in the performance of duty as men in other lines of business. They should be much more so, because of the great responsibility which their duties place upon them. Perhaps as a class they are doing as well as should be expected in view of all the circumstances. But the accident record shows that something is wrong somewhere. What is it? In the first place we do not make proper and sufficient investigation of the moral and mental qualifications of the men we employ in the more responsible branches of the service. Under the system now prevailing on most roads, almost any man of prescribed age who can pass a physical examination can get a responsible position in railroad service. In nine cases out of ten, we take the references given by the applicant, write them formal letters of inquiry and the butcher and the barber, the teamster and the trader do the rest. The duty of employing new men is generally delegated by officials in charge to their assistants and by them further delegated down the line until it often happens that a clerk is the only one, other than the examining physician, who sees or knows anything about the applicant before he reports for duty.

Instead of this method, there should be on every road, a central employment bureau with branches at important points which should have sole authority in the employment of men. This bureau should encourage—if necessary should advertise for—applicants and should make a careful and thorough investigation of the antecedents and of the personal record of every applicant. We could and we should have in charge of our trains the finest body of men in the world. The work is attractive, even fascinating, the pay is good and the chances for advancement encouraging. The most popular toy in the world for boys is an engine and string of cars and when these boys grow up, they all want to go railroading. We don't need them all, but we could, if we went about it in the right way, select the best of them. When a country boy whose ancestry back to Adam has been as clean as a hound's tooth, who has been taught from the cradle to respect and obey authority, who doesn't know how to shun work or shirk a duty—when that kind of boy comes timidly into a railroad office today and applies for a job—if we don't happen to need men at the time, the employing officer or more likely his clerk says—"Can't do anything for you now." The boy goes and gets a job clerking at ten dollars a week. A few months later there is a rush of business and we need men, but we have no waiting list—we don't even take names and addresses of applicants and consequently we have to take anything we can get on short notice and that often means the boomer and the loafer.

Even this method wouldn't be so objectionable, if we gave every new man a careful and thorough training, in fact a schooling in his branch of the service before allowing him to go to work, but we don't do that, that is, we don't carry it far enough.

One of the most important duties confronting safety organizations today is to arouse the interest of employes, and educate them to safe methods in the performance of their duties. Employes indulge in unsafe practices to a great extent because the importance of safety in routine matters has not been fully impressed upon their minds. It is sometimes claimed by employes and by those who represent them that railroad officials do not in fact mean that employes shall comply with many of the rules relating to safety. They contend that these rules are put out because they read well, but that it is understood and expected that they will be violated whenever it is necessary in order to avoid delay in the performance of their duties. This view is perhaps shared to some extent by certain minor officials in direct charge of the men, and in promoting safety it should be borne in mind that the attitude of the yardmaster, and the round house foreman toward the safety movement, being observed and understood by individual employes, is often more potent than that of the general manager, whose views are known by employes only in a general and indefinite way. Instructions may positively forbid trainmen to go between moving cars for any purpose. The general manager, the superintendent, and every other official may desire that the instructions shall be complied with, regardless of delay which may be occasioned thereby, but if the yardmaster is permitted to remain indifferent to the neces-

Fig. 16—Coal Too Near Rail which Might Cause a Trainman to Fall Under Car.

Fig. 17—Lumps of Coal from Overloaded Car or Tender, which Might Cause Injury.

3. "To the New Man," a card containing upon one side a few sentences on the importance of safety and on the reverse side a number of safety precautions. This card is delivered by the employing officer to every new man entering the train service.

4. "Safety Cards," containing one or two terse sentences bearing on safety. These cards are 6x9 inches, of heavy card board. They are posted in stations, depots, towers, shanties, shops, and at other places where necessary to reach the attention of employes in all branches of service, different colors being used for each issue.

5. "Machine Signs." These are tin or enamel signs 3x4 inches with white letters on red back ground reading: "Stop This Machine Before Repairing, Oiling or Wiping." This sign is attached to every machine, the nature of which makes such warning at all necessary.

6. "Trespassers Killed on Railways—Who Are They?" This is a pamphlet of 12 pages 4½x7¼ inches, by the general claims attorney, New York Central Lines, in which it is shown that the greater number of persons killed while trespassing on railroad property are not tramps or hoboes, as is generally supposed; but citizens of the community who use railroad property in going to and from their work, or

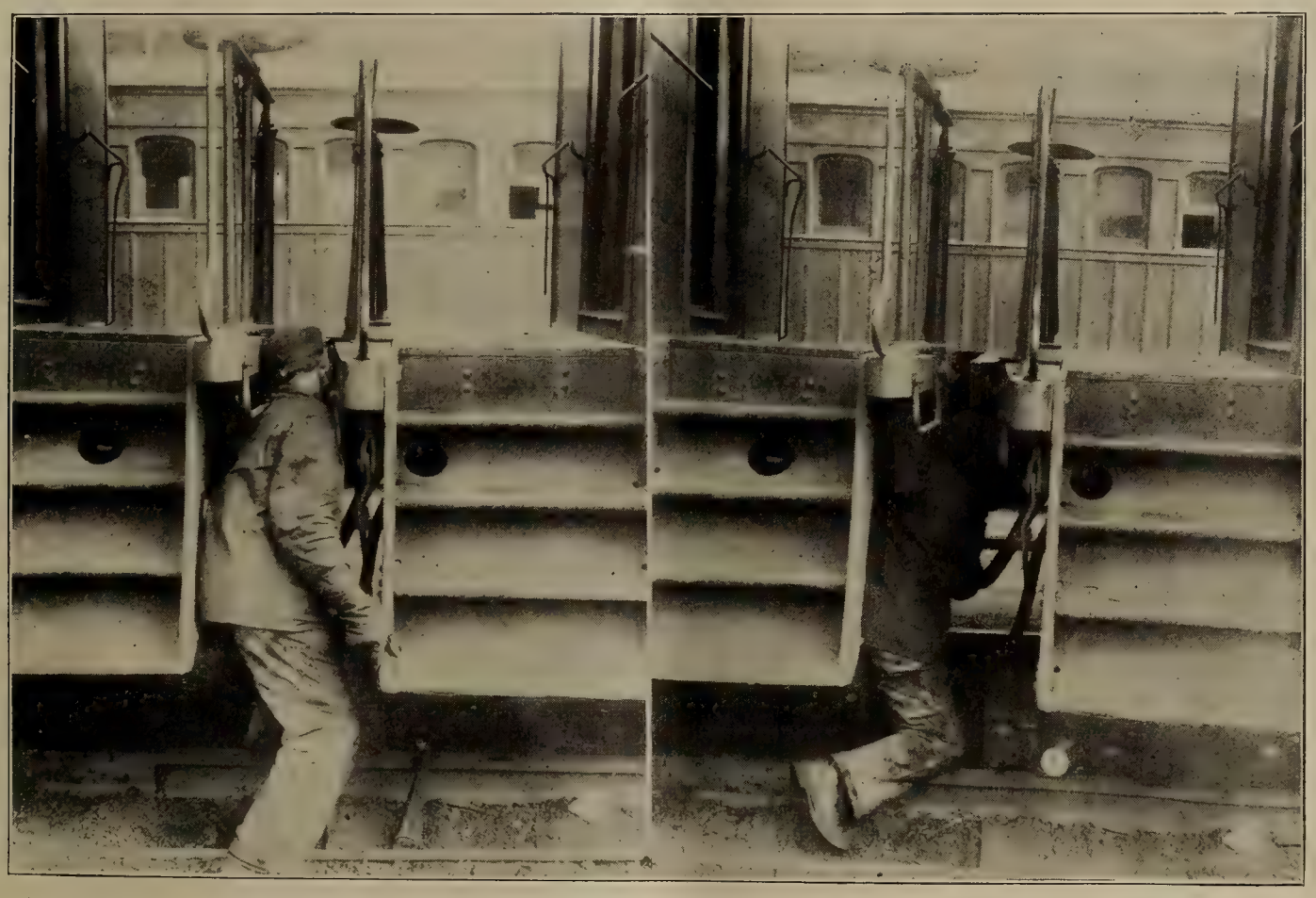


Fig. 19—The Unsafe Way—Head Between Platforms, and the Safer Way—Head Clear of Platforms.

sity for compliance with such instructions their enforcement will be difficult and to a great extent impossible.

We must first convince employes and officials in immediate charge when necessary, that a new condition of affairs has arisen and that whatever may or may not have been true in the past we have now learned to say and mean "Safety First."

On the New York Central Lines we are trying to convey safety education to employes by means of literature, illustrated lectures and personal instructions.

Some of the literature used for educational purposes:

1. "Prevention of Railroad Accidents," a lecture by the general safety agent bearing chiefly upon the "human element."

2. "Our Safety Department," a pamphlet calling attention to certain unsafe conditions and practices and showing methods of correction.

Fig. 18—Scrap Bins Located at Convenient Points in Large Yards for the Deposit of Scrap, which Employes are Required to Pick Up Promptly.

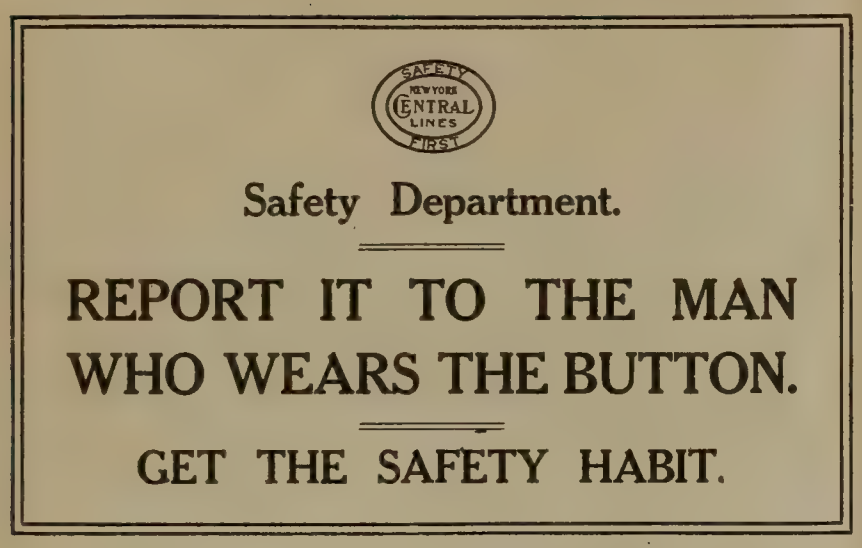


Fig. 20—One of the Safety Cards.

for other personal purposes. This pamphlet, we are distributing to federal, state, county and city officials, as well as to a few prominent citizens in each community.

7. "Safety." This is an illustrated magazine 6x9 inches, twenty pages, being the official organ of the general safety committee. One copy of this publication is placed in the hands of every employe on the New York Central lines who can read English.

We find that employes are glad to receive this literature and that they read it attentively.

In addition to the distribution of literature, lectures, illustrated by stereopticon views, bearing on unsafe practices and conditions are delivered by the general safety agent at important centers. Printed notices of the time and place of these lectures are distributed among all employes who may be able to attend. Attendance is wholly voluntary but so great has been the interest manifested that we have not had a meeting at which the attendance was less than five hundred and, in many cases, it has run as high as fifteen hundred to twenty-five hundred.

We believe—in fact, we know—that a great deal of good has been accomplished by means of this educational campaign.

We also have almost completed a "Safety Exhibit Car" which will contain models of approved safety devices, safety literature, photographs showing safe and unsafe practices and conditions, material, tools and appliances which have broken or given away, resulting in injuries or which might have resulted in injuries, and other matters of interest. This car, in charge of a competent man, will be exhibited at all important points where employes will be given an opportunity to see what is being done for the prevention of injuries. Every employe on the system will be required to visit the "Safety Exhibit Car." (We hope, however, to make the exhibit of such attractive nature that employes will be glad to visit it.) Each employe will receive from the man in charge of the car safety instruction in his particular branch of the service. In other words, in addition to its being a "Safety Exhibit Car," it will also be a "Safety Instruction Car." The public will also be invited to visit the car.

The "Safety First" movement from its very nature appeals to the higher sentiments of officials and employes, and, therefore, it is very easy to become highly interested, even enthusiastic in the work, but after all the true measure of this work should be determined by actual results. In other words, after a movement has been in effect a reasonable time, results in the nature of a decrease in injuries should be expected and demanded.

In this connection, I quote as follows from the February issue of "Safety," the publication already referred to, showing the decrease in accidents in New York Central shops. [This was published on page 56 of the February issue of the *Railway Master Mechanic*.—Editor.]

In the six months, June to November, 1912, as compared with the same period of 1911, there was a decrease of 15.4 per cent in the total number of employes killed in all branches of the service on the New York Central Lines, East and West. In noting this, it should be borne in mind that the volume of business for 1912 period was much heavier and consequently the number of persons employed considerably greater than in the 1911 period. For this reason, the actual percentage, if figured on volume of business and number employed, would show a much greater decrease.

The safety first movement has already proved a revelation. It will in time work a reformation.

GAS-ELECTRIC MOTOR CARS, C., M. & & ST. P. RY.

The Chicago, Milwaukee & St. Paul Ry. has recently placed in service two General Electric Company gas-electric motor cars on branch lines in the state of Washington. One of these cars, No. 300, is operating between Everett and Monroe, a distance of 14 miles, and makes five single trips per day, totaling 70 miles; while the other car, No. 301, runs from Seattle via Cedar Falls to Enumclaw, a distance of 62 miles, and makes one round trip each day, covering 124 miles.

The cars are of the combination passenger, smoking and baggage compartment type. They are 70 ft. 5 in. long, 10 ft. 5 in. wide, weigh approximately 50 tons and have a total seating capacity for seventy-seven people. The cab in front, containing the power plant apparatus, measures 11 ft. 11 in. long; next is the baggage room, 15 ft. long; then the smoking section, 10 ft. 11 in. long, and the passenger compartment, 27 ft. 5 in. long. A center vestibule, with side entrances, runs crosswise between the passenger and smoking compartments. The smoking section provides for twenty, and the passenger compartment for fifty-seven of the total seating capacity. The roof and rear are of the "turtle back" design.

Standard all-steel construction, except in the case of the interior finish, prevails throughout the cars. The frame consists of steel I-beams and channels, strongly cross-braced, and steel plates form the outside sheathing. The underfloor of the car is of wood, while between this and the floor proper a heavy felt lining is inserted, and the car sides are also interlined with felt.

The interior trim is of mahogany, highly finished, and the ceiling is sheathed with composite board. The windows are fitted with plate glass; the seats are made long enough to accommodate three persons, are covered with friezette plush in the passenger compartment and with genuine Spanish leather in the smoking room, and the entire car is lighted with attractive electric incandescent fixtures.

The generating unit is the standard type and is located above the floor line of the cab, free from dust and dirt and under immediate observation of the engineer. It consists of an 8-cylinder, 4-cycle gas engine of the "V" type, direct connected to a 600-volt commutating pole electric generator, designed to meet the special conditions the service demands. Flexibility of control and economy of operation result from electrical transmission of the power. Starting the engine is effected by compressed air taken from the main reservoirs of the air brake system, which are built with surplus capacity for this purpose. The main air compressor is driven from the crank shaft of the main engine and is fitted with an automatic governor, which maintains a constant pressure. The engine can rotate at normal speed, irrespective of the speed of the car, and deliver its maximum power, a feature of great advantage on grades in case of snowstorms or other emergency conditions.

An auxiliary equipment is also provided, consisting of a 2-cylinder, 4-cycle gas engine direct connected to a single cylinder air compressor and lighting generator. The function of this set is to supply an initial charge of air for starting

the main engine and to deliver power for lighting the car. The set is started by hand.

The control is simple, substantial and similar to that of any standard electric trolley car. Mounted on the axles of the forward truck are two GE-205, 600-vot, box-frame, oil-lubricated, commutating pole railway motors of 100 h. p. each. Years of experience have demonstrated that no piece of apparatus is less liable to derangement than the railway motor built for heavy high-speed traction work. By means of a special controller the motors are placed progressively in series and parallel connection.

The controlers are also arranged for governing the motors by shunting the fields in obtaining the desired final speed acceleration. This auxiliary method of control assures greater operating efficiency through continuous saving of power, economy effected by decrease in the weight of the equipment and an increase in the service capacity. Two extra points are provided on the controller for final speed acceleration in parallel, whereby the motor fields are shunted and weakened. The resulting higher armature speeds permit the use of smaller pinions, and full utilization of the power input is secured throughout the entire speed range from start to full speed.

Energy is transmitted directly without the intervention of mechanical change speed gearing. The voltage is governed by varying the strength of generator field, which is accomplished by the movement of a single handle on the controller, and the resultant speed changes of the motors produce a smooth and rapid acceleration without rheostatic power losses or gear changes. Separate hndles are provided for throttling the engine and for reversing the car. The latter is accomplished instantly by changing the motor connections in the usual manner without stopping the engine, which always rotates in the same direction. This allows the cars to be brought to a halt quickly independent of the brakes in an emergency. All the levers are located within convenient reach of the operator. The radiators are placed on the roof, and circulation for cooling the engine is maintained by the thermo-siphon system.

The trucks are of the swing bolster type, with elliptic bolster springs and coil equalizer springs. The bearings, treads and flanges of the wheels and axles conform to the standards of the M. C. B. The brake equipment includes hand brakes in addition to the combined straight and automatic air brakes. A high-power Mazda incandescent headlight and reflector, an air whistle and pneumatic gong are provided. A hot water heater, coal fired, is installed for heating the car. To prevent freezing in cold weather, when the car is lying idle, the heater circulation may be connected to the engine cooling system. A 150-gallon gasoline tank for the power supply is suspended under the car. While the engine is running the gasoline is pumped automatically, and when starting by a hand pump.

It is interesting to note that these cars made the long trip across the western continent under their own power. Car No. 300, operating between the terminals Everett and Monroe left Chicago on the Chicago, Milwaukee & St. Paul tracks and covered the distance to Tacoma, Wash., 2,201.2 miles, in ten days, daylight running. While this is probably the longest single run of a self-propelled car, it is not exceptional, as similar records are being duplicated every day by cars of this type in actual service.

Necessarily, the special schedules of the motor cars while on the trip were subject to the exigencies of regular traffic requirements, and numerous blocks, slowdowns and layovers were encountered. The car in question averaged 220 miles per day, and one day covered 315 miles. A run from Malden to Othello, Wash., 103 miles, was made in 2 hours and 10 minutes, and in one case 20 miles of 2.2 per cent grade were negotiated in 56 minutes with one stop.

CONVENTIONS FOR 1913.

The convention season is again approaching and we give herewith the dates of the annual conventions of the various associations together with the subjects to be covered by each. May is the month containing the greatest number of conventions of interest to the railway mechanical man. During that month there are four conventions—the Air Brake Assn., the Storekeepers, the Fuel Assn., and the Master Boiler Makers. Three of these are to be held at Chicago. The Master Mechanics and Master Car Builders meet at Atlantic City from June 11 to 18; this being the only convention during that month. The work of the committees of this association is well known as many of them are continued from year to year. A full report of the proceedings of the Atlantic City conventions will be published in the July issue of the *Railway Master Mechanic*. In July there is but one convention, that of the Tool Foremen. In August the Master Blacksmiths, Traveling Engineers and Chief Interchange Car Inspectors and Car Foremen meet, and in September comes the meeting of the Master Car & Locomotive Painters. It will be noted that six of these conventions will be held at Chicago. The list of subjects cover a wide range and indicate the most important problems before the mechanical field today. These associations embrace most of the officials of the mechanical departments and any railway man not connected with one or more, representing his particular line of endeavor, would do well to get in touch with the secretaries of such organizations.

Air Brake Association.

The twentieth annual convention of the Air Brake Association will be held at the Planters Hotel, St. Louis, on May 6 to 9, inclusive. The subjects and committees selected are as follows:

"Will the Triple Valve Operate as Intended? That Depends."—S. W. Dudley.

Gas-Electric Motor Car, C. M. & St. P. Ry.

"Starting, Running and Stopping Long Freight Trains."—F. B. Farmer.

"Undesired Quick Action, its Prevention and Remedy."—C. N. Remfry.

"Clasp Type of Foundation Brake Gear."—T. L. Burton.

"Friction and Wear of Brake Shoes."—Robert C. Augur.

"Recommended Practice."—S. G. Down, Chairman; Geo. R. Parker, H. A. Wahlert, J. R. Alexander, N. A. Campbell.

Topical Subjects—

"Air Hose Failures."—T. W. Dow.

"Steam Heat Drips."—C. W. Martin.

As topical subjects are always interesting and instructive, each member is invited to send a topical subject to the secretary as early as possible, so same may be placed before the executive committee for consideration as to its being presented to the convention meeting.

H. A. Wahlert has resigned as president of the association, having accepted a position with the Westinghouse Air Brake Co. The executive committee has ratified the advancement of first vice-president W. J. Hatch to the presidency of the association. Mr. Hatch is general air brake inspector of the Canadian Pacific at Montreal. F. M. Nellis, 53 State St., Boston, Mass., is secretary of the Air Brake Association.

American Railway Tool Foremen's Association.

The annual convention of the American Railway Tool Foremen's Association will be held at the Hotel Sherman, Chicago, July 22, 23 and 24, 1913. Following are the subjects to be considered:

"Reclaiming Scrap Tool Steel."

"Making and Maintaining Thread Cutting Dies."

"Making and Maintaining Forging Machine Dies."

"Superheater Tools and Their Care."

"The Electric Furnace for Tempering Tool Steel."

"The Form of Thread and Degree of Taper for Boiler Studs and Plugs."

A number of circulars are being sent out urging the attendance of members and every effort is being made to have a successful convention. The secretary-treasurer is A. R. Davis, 750 Pine St., Macon, Ga.

Chief Interchange Car Inspectors and Car Foremen's Assn.

At a meeting of the executive committee of this association, report of which is given elsewhere, it was decided to hold the next annual convention at Minneapolis, Minn., on August 26, 27 and 28, 1913. Stephen Skidmore, 6th and Millcreek, Cincinnati, O., is secretary-treasurer of the association. The meetings are devoted to discussions and interpretations of interchange rules, and to papers of interest to car men. "The freight agent solicits business, unschooled car inspectors divert it; supervision is at fault. The makers of interchange rules expect accurate interpretation. A thorough understanding of the book of rules and the general interchange situation, national harmony, national honesty, and national unity of action everywhere by everyone, is the purpose of the association. The object sought must be accomplished and will solve the extensive problem."

General Foremen's Association.

The 1913 convention of the International Railway General Foremen's Association will be held at the Hotel Sherman, Chicago, on July 15th to 18th, inclusive. These are the subjects to be taken up at the meetings, together with the committee chairmen:

"Maintenance of Superheater Locomotives."—R. C. Fink, Chairman.

"Engine House Efficiency."—Wm. Smith, Chairman.

"Shop Schedules."—L. A. North, Chairman.

"Driving Box Work."—Geo. H. Hogan, Chairman.

The secretary-treasurer of this association is William Hall, who is now located at 829 W. Broadway, Winona, Minn.

Master Blacksmiths' Association.

The twenty-first annual convention of the International Railroad Master Blacksmiths' Association will be held at the Hotel Jefferson, Richmond, Va., on August 19, 20 and 21, 1913. Committees have been appointed to report on the following subjects:

"Flue Welding"

"Making Frogs and Crossings, and Repairing."

"Carbon or High Speed Steel."

"Tools and Formers."

"Electric Welding."

"Drop Forging."

"Spring Making and Repairing."

"Piece Work and Other Methods of Having Work Done."

"Locomotive Frame Making and Repairing."

"Oxy-acetylene Process for Welding and Cutting of Metals."

"Case Hardening."

"Heat Treatment of Metals."

"Shop Kinks."

The secretary-treasurer of the association is A. L. Woolworth, C. H. & D. Ry., Lima, O.

Master Boiler Makers' Association.

The next annual convention of the Master Boiler Makers' Association will be held at the Hotel Sherman, Chicago, on May 26, 27, 28 and 29, 1913. Following are the subjects to be covered:

"How many rows of expansion stays is it advisable to apply to crown sheet to secure the most efficient service, considering the wear and tear of boiler?"

"Is there any limit to the length of a tube in a boiler without a support midway of boiler and will a support prove objectionable in circulation?"

"When is a boiler in a weak and unsafe condition?"

"Best method of welding superheating tubes, and tools used for same."

"What effect does superheaters have on the life of fireboxes and flues?"

"What are the advantages or disadvantages of using oxy-acetylene and electric processes for boiler maintenance and repairs?"

"The proper inspection of a boiler while in service."

'Best form of grate to be used to insure removing of fire at terminals with the least abuse to the fire box and flues, insuring the most economy as well as high efficiency in service."

"The best method of applying and caring for flues while engines are on the road and at terminals."

"Steel vs. iron tubes. What advantages and what success in welding them and advantages of either in maintenance, mileage, etc."

"What benefit has been derived from treating feed water for locomotive boilers, chemically or otherwise?"

Harry D. Vought, 95 Liberty St., New York, is the secretary.

Master Car & Locomotive Painters' Association.

The annual convention will be held at Ottawa, Canada, on September 9th to 12th, 1913. The subjects were decided upon at the advisory committee meeting held at Philadelphia on February 22. A. P. Dane, Reading, Mass., is the secretary-treasurer of this association.

Railway Fuel Association.

The 1913 meeting of the International Railway Fuel Association will be held at the Hotel Sherman, Chicago, May 21st to 24th. The subjects were printed in the February issue of the *Railway Master Mechanic* but for convenience are here repeated as revised:

"Standard Form of Contract Covering the Purchase of Railway Fuel Coal."

"Location, Construction, Development and Operation of a Bituminous Coal Mine."

"Sub-Bituminous and Lignite Coal as a Locomotive Fuel."

"The Internal Combustion Engine as Applied to Railway Service."

"Scaling of Locomotive Boilers and resultant fuel loss."

"History of Brick Arch in Its Relation to Locomotive Operation and Fuel Economy."

"Modern Locomotive Coaling Station—Its Design, Construction, Operation and Maintenance."

"A Uniform Method of Computing Locomotive Fuel Consumption."

C. G. Hall, 922 McCormick Bldg., Chicago, is secretary-treasurer.

Railway Storekeepers' Association.

The tenth annual convention of this association will be held at the Hotel Sherman, Chicago, Ill., on May 19, 20 and 21, 1913. This supercedes all previous announcements it being noticed that there has been a change in the hotel. J. P. Murphy, Box C, Collinwood, O., is secretary-treasurer of this organization. The list of subjects for the coming convention were published in the January issue of the *Railway Master Mechanic* and are repeated here:

Regular Subjects.

"Reducing Inactive and Disposing of Obsolete Stock."

"Rolling Mills at Railroad Scrap Docks. Economy Effected."

"Couplers and Parts, M C B. Marking by Manufacturers for Identification."

"What Effect, if Any, Has a Well-Organized Store Department on the Operating Cost of a Railroad?"

The topical subjects which are to be continued are "standards" of the following: "Store House," "Store-House Casting Platforms," "Oil House and Waste Storage," "Dry Lumber Shed," "Stationary Store House," "Supply Car," "Scrap Dock and Reclaiming Machinery."

The above to be exemplified by necessary drawings, arranged on unit basis, so that any road may draw on such standards, according to requirements. Other topical subjects are:

"Specifications for, and Testing Material, and Effect on Storekeepers' Stock."

"Ice—Proper Method of Storage, Disbursement, Shrinkage and General Handling on Railroads."

"Standard Book of Rules Governing Store Department Practices."

Traveling Engineers' Association.

The twenty-first annual convention will be held at Chicago during August, 1913.

The following subjects will be reported on by committees:

"Uniform Instruction to Enginemen on the Handling of Superheater Locomotives."

"Credit Due the Operating Department for Power Utilization and Train Movement that Reduces the Consumption of Fuel per Ton Mile."

"The Care of Locomotive Brake Equipment on the Road and at Terminals; also Methods of Locating and Reporting Defects."

The following papers will be presented:

"Advantages Obtained with the Brick Arch in Locomotive Service."

"What Can We Do to Eliminate the Black Smoke Evil on Locomotives?"

"Scientific Train Loading—Tonnage Rating. The Best Method to Obtain Maximum Tonnage Haul for the Engine Over the Division, Taking into Consideration the Grades at Different Points on the Division."

W. O. Thompson, East Buffalo, N. Y., is the secretary of this organization.

TIMELY REPAIRING OF FOREIGN CARS.

By Wm. P. Elliot, F. C. D., Wiggins Ferry Co., East St. Louis, Ill.

A great deal has been said and written, and many recommendations made, regarding the car known to the railroad man as the "buzzard," which is, in reality, a dilapidated old "bad order-home empty" car, but, notwithstanding all this, the railroads still have this class of cars with them.

As long as these cars are allowed on the railroads, so long as they are not repaired, no railroad wants them, consequently they are juggled about between connections until eventually some one stops this, then the proper disposition is procured and the car is billed home, after which it begins a journey across the country, occupying thirty-six or forty feet of space in a trunk line train, giving the railroads over which it traverses nothing in return, most likely occupying space in train which might be occupied by a loaded freight car, and maybe running away from a load of freight waiting for a car like it in the yard where it originally failed and where it could have been repaired. Additionally, when the car reaches its destination in all likelihood the best part of it is damaged beyond redemption, and the chances are there will be nothing but the trucks of the car which can thereafter be put to use.

There would be a different story in connection with this class of cars if there were an agreement between the railroads to have a diagnostician in each territory to pass on them; in large terminals, for instance, the chief interchange car inspector. After his verdict, 48 hours would put about 90 per cent of the cars in serviceable condition and ready for loading in the yard where the chief interchange inspector or one of his assistants rendered the decision. There are numerous daily cases of this kind in every large terminal, and the railroads are robbed of the service of many of these vehicles of commerce simply from the want of co-operation between the railroads, a co-operation that would authorize some one to give this class of equipment the consideration it deserves.

If the railroads had located at every large terminal in the United States a central car repair shop, equipped with modern machinery, for handling both wood and steel cars, and the railroads provided in each terminal territory an official umpire (some centers already have this official in the person of the chief interchange inspector) to represent foreign car owners in all matters pertaining to repairs on railroads, they would eliminate a great deal of delay, an enormous amount of extra switching, the road haul of cars, and save accumulated correspondence relating to the cars.

It is discouraging to witness road trains with from one to six empty cars in them marked "Bad Order—Home Empty." There are so many of these cars that some of the larger systems have special cards printed ready to be tacked on them. The forwarding of the cars is likewise a hardship on intermediary lines; all railroads have enough of these bad orders of their own, but when they come to getting them from one railroad and carrying them over to another, it hurts the efficiency of the intermediary line and causes it to perform wasteful work. This unnecessary mileage of bad order empty cars could, if the railroads had centrally located general car repair shops in large terminals, be so reduced as to be a negligible quantity, whereas under present conditions it is an expensive waste and a serious financial loss to the railroads.

The majority of the railroads entering large terminals have only light repair tracks, consequently when a car is in need of heavy repairs they have to haul it one hundred and fifty or two hundred miles to the shop. A general repair shop, such as has been recommended, would avoid this mileage.

The steel car is fast becoming an important consideration. Very few of the railroads, especially at large terminals, are equipped to handle this class of equipment. These cars could

also be handled in a centrally located general repair shop, and the work could be done more promptly and more cheaply than it can be accomplished by a railroad having nothing but a light repair yard and not properly equipped to take care of heavy repairs.

Such a general repair yard could, too, be established jointly and operated on a joint basis, to begin with, if necessary, by two or more railroads; the more of them that could be gotten in on the arrangement in a particular terminal the better, as it would necessarily require a large outlay of money; however, it would soon pay for itself when the empty mileage, the necessary switching, the increase in car efficiency and other time-losing and money-losing items are taken into account.

The tendency has been to constantly increase and improve the inspection on cars, and this has developed to such an extent that the railroads have lost sight of the fact that if they did more repairing there would be less inspecting to do, and a better class of cars to inspect.

Every car department official in the United States, as well as each operating officer, should lend his voice and influence towards the standardization of couplers and the standardization of draft gearing. When we have a standard coupler and draft gear the improvement in freight cars and the upkeep of them will take a stride far beyond the expectations of the most optimistic, and, finally, it is to be hoped that some day, through the American Railway Association or the Master Car Builders' Association, the railroads may even have wholly standard classes of cars.

INCREASING SIZE OF BRITISH LOCOMOTIVES.

On February 5th there was put out a new type of London and North Western (England) locomotive. This engine is of the non-compound type, with four cylinders and uses superheated steam. It has six-coupled driving wheels and is what is known as the 4-6-0 wheel arrangement. The coupled wheels are of much larger diameter than others of this arrangement on the London and North Western—namely, 6 ft. 9 in. diameter, instead of 6 ft. The four cylinders are 16 in. diameter by 26 in. stroke, and all drive on to the leading pair of coupled wheels.

It is interesting to compare the tractive effort which the engine should develop with these large cylinders, with the stated tractive effort of other large engines now becoming familiar sights on the more important British lines. The four 15 in. by 26 in. cylinders of the "Green Bear," whose construction by the Great Western in 1908 aroused much attention, give a tractive effort of, roundly, 21,160 pounds, on the assumption that the mean effective pressure in the cylinder is 60 per cent of the boiler pressure, which is 225 pounds. The combined piston area of the new engine is about 12 per cent greater and the boiler pressure about the corresponding amount less, i. e., 200 pounds. The tractive effort is calculated on the same basis, and neglecting a slight difference in the size of the driving wheels, should be about the same as that of the "Green Bear," and about 10 per cent more than that of the handsome new Great Central engine, "Sir Sam Fay," which has two cylinders of 21½ in. by 26 in., works at 160 pounds boiler pressure and drives through wheels of 6 ft. 9 in. diameter. The latter is said to be the most powerful two-cylinder engine running in England.

The valve gear of the new engine is of the Walschaerts type and is placed outside the frames, a position not common in this country but very much so in Europe. The boiler is 14 ft. 6 in. in length and 5 ft. 2 in. diameter, having a Belpaire fire-box, sloping grate, and Schmidt superheater. Mechanical lubrication is employed. A Ramsbottom type of safety valve is fitted for a working pressure of 200 pounds per square inch, and it is noticeable that there are not two safety valves fitted, as is the case with the latest engines of this size of other companies. The outside cylinders are placed low down, and viewed from the front are so masked that the engine presents the self-contained appearance of an inside-cylindered locomotive. Another feature is the great extent of splasher, running along the frames and largely covering the outside valve gear, thus keeping up the cult of external neatness which was brought in at Crewe by Mr. Ramsbottom and kept up by his successors. The cab is of the latest London and North Western type as introduced by Mr. Whale, but owing to the large Belpaire firebox the windows are elongated in shape, this being of course due to the British loading gauge restricting the height of the cab roof. The engine is numbered 2222, and bears the date of January, 1913, and the runningshed number of Crewe (15). Even in its present coat of lead color the engine is handsome and neat in appearance, and gives an impression of great power.

The advent of this new class on the London and North Western Railway has been talked about in railway quarters, for some time, and it is probably correct to assume that Bowen Cooke was influenced in designing them, by the data accumulated from the interchange of locomotives with the Great Western two or three years ago. It will be recalled that a Great Western four-cylindered engine then hauled, for a period, important expresses between Euston and Crewe, while a two-cylindered 4-6-0 express engine of Mr. Whale's design hauled some of the crack expresses between Paddington and Exeter. Still this is not the first London and North Western venture in the direction of a four-cylindered simple engine. In 1897 the late Mr. Webb built a four-cylindered simple engine of the 4-4-0 type and a four-cylindered compound engine of the same type, and pitted them against one another. It was a half hearted attempt, however. The boiler power was not sufficient and the experiment was generally supposed to have been made to give the excuse of persisting with the Webb system of compounding. At any rate, the engine steamed badly, and, was converted to a compound, in which form it still runs. Mr. Bowen Cooke's engine is of a very different type, and it will be exceedingly interesting to watch its performances compared with sister engines on the Lancashire and Yorkshire, London and South-Western and Great Western Railways, especially as regards steaming capacity and tractive force.

COURAGE.

Discouraged, eh? The world looks dark,
And all your hopes have gone astray;
Your finest shots have missed the mark,
You're heartsick and discouraged, eh?

Plans that you built from all went wrong,
You cannot seem to find the way,
And it seems vain to plod along,
You're heartsick and discouraged, eh?

Take heart! Each morning starts anew;
Return unto the battle line;
Against far greater odds than you
Brave men have fought with courage fine.

Despite the buffetings of fate,
They've risen, time and time again,
To stand face front and shoulders straight
As leaders of their fellow men.

And you, now blinded by despair,
Heartsick and weary of the fight,
On every hand beset by care,
Can, if you will, attain the light.

—Edgar A. Guest in *Detroit Free Press.*

Mikado Locomotives, Atlanta, Birmingham & Atlantic R. R.

The Atlanta, Birmingham & Atlantic has recently placed in service five Mikado type locomotives which were built by the Baldwin Locomotive Works. These engines exert a tractive force of 45,000 pounds; the ratio of adhesion is 4.17, and with driving wheels 57 inches in diameter; they are specially fitted for heavy slow-speed service. In accordance with the latest practice for locomotives of this type, they use highly superheated steam.

The most interesting feature, in this design, is the boiler, which is fitted with the Gaines type of firebox and combustion chamber. This style of furnace originated on the Central of Georgia Railway, and the results thus far obtained with it have been highly satisfactory. Not only has there been an economy in fuel consumption per ton mile, but failures due to boiler troubles have been largely reduced, and there has also been a marked reduction in the amount of smoke emitted when using high volatile coal.

The frames are steel castings 5 inches wide, with single front extensions 11 inches deep under the cylinders. Transverse braces of cast steel are placed at the first, second and third pairs of driving pedestals, and also back of the fourth pair, where the rear frames are spliced to the main frames. The rear truck is of the Hodges radial type, with outside journals.

The tender has a capacity for 7,500 gallons of water and 12 tons of coal. The frame consists of 12-inch channels, and the trucks are of the equalized pedestal type, with Standard rolled steel wheels.

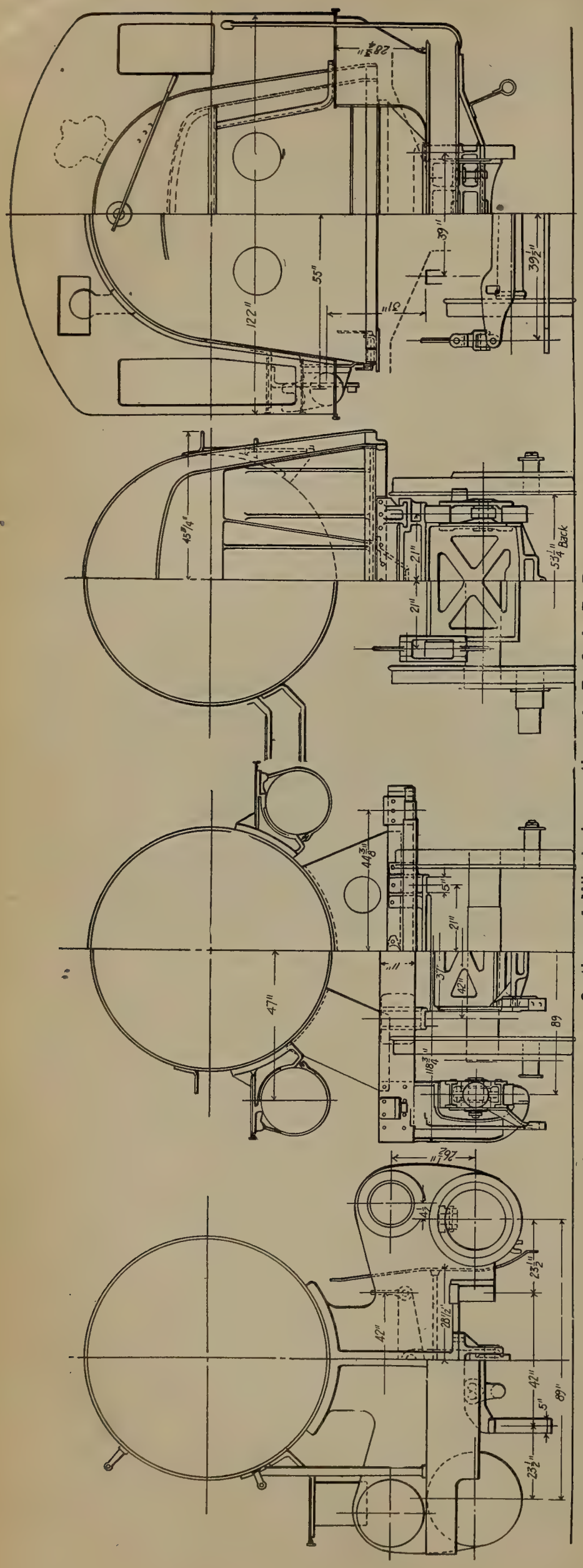
The principal dimensions of these locomotives are given in the table:

Gauge	4 ft. 8½ in.
Cylinders	24 in. x 30 in.
Valves	Balanced Piston
Boiler—	
Type	Straight
Material	Steel
Diameter	76 in.
Thickness of sheets	¾ in.
Working pressure	175 lbs.
Fuel	Soft Coal
Staying	Radial
Fire Box (Gaines)—	
Material	Steel
Length	134 in.
Width	84 in.
Depth, front	68 in.
Depth, back	65½ in.
Size of grate	89 in. x 84 in.
Thickness of sheets, sides	⅜ in.
Thickness of sheets, back	⅜ in.
Thickness of sheets, crown	⅜ in.
Thickness of sheets, tube	5/16 in.
Water Space—	
Front	4½ in.
Sides	4 in.
Back	4 in.
Tubes—	
Material	Steel Iron

Mikado for the Atlanta, Birmingham & Atlantic.

As applied to the new Mikado type locomotives, the firebox is 134 inches long by 84 inches wide, and is not unlike the Wootten type in shape. The actual length of the grate, however, is only 89 inches. Firing is accomplished through two circular doors placed 36 inches apart transversely; and a power grate shaker is applied. The front part of the furnace is used as a combustion chamber and is separated from the rear part by a brick wall. Provision is made for discharging pre-heated air in a backward direction at the top of this wall. This aids in the combustion of the gases, and because of the manner in which the air is discharged from the wall keeps the rear of the firebox filled with flame, thus increasing the effectiveness of the crown and back sheets as heating surface. Any cinders which accumulate in the combustion chamber can be readily removed through a cinder chute.

The superheater is of the Schmidt top-header type, composed of 32 elements. Steam is conveyed to the steam chests through outside steam pipes. The distribution is controlled by inside admission piston valves, which are 13 inches in diameter. The Baker valve gear is used, and reversing is effected by the Ragonnet power gear. This device has been applied by the builders to a large number of locomotives of various classes with most satisfactory results.



Sections of Mikado Locomotives, A. B. & A. R. R.

Thickness	No. 9 W. G.	No. 11 W. G.
Number	32	234
Diameter	5⅜ in.	2 in.
Length	17 ft. 8 in.	17 ft. 8 in.
Heating Surface—		
Fire box		210 sq. ft.
Combustion chamber		sq. ft.
Tubes		2,946 sq. ft.
Firebrick tubes		sq. ft.
Total		3,156 sq. ft.
Grate area		51.9 sq. ft.
Driving Wheels—		
Diameter, outside		57 in.
Diameter, center		50 in.
Journals, main		11 in. x 12 in.
Journals, others		10 in. x 12 in.
Engine Truck Wheels—		
Diameter, front		30 in.
Journals		6½ in. x 10½ in.
Diameter, back		40 in.
Journals		8 in. x 14 in.
Wheel Base—		
Driving		15 ft. 0 in.
Rigid		15 ft. 0 in.
Total engine		32 ft. 4 in.
Total engine and tender		64 ft. 11 in.
Weight—		
On driving wheels		187,700 lbs.
On truck, front		27,300 lbs.
On truck, back		34,900 lbs.
Total engine		249,900 lbs.
Total engine and tender		390,000 lbs.
Tender—		
Wheels, number		8
Wheels, diameter		33 in.
Journals		5½ in. x 10 in.
Tank capacity		7,500 gals.
Fuel capacity		12 tons
Service		Freight

Engine equipped with Schmidt superheater.
Superheating surface, 663 sq. ft.

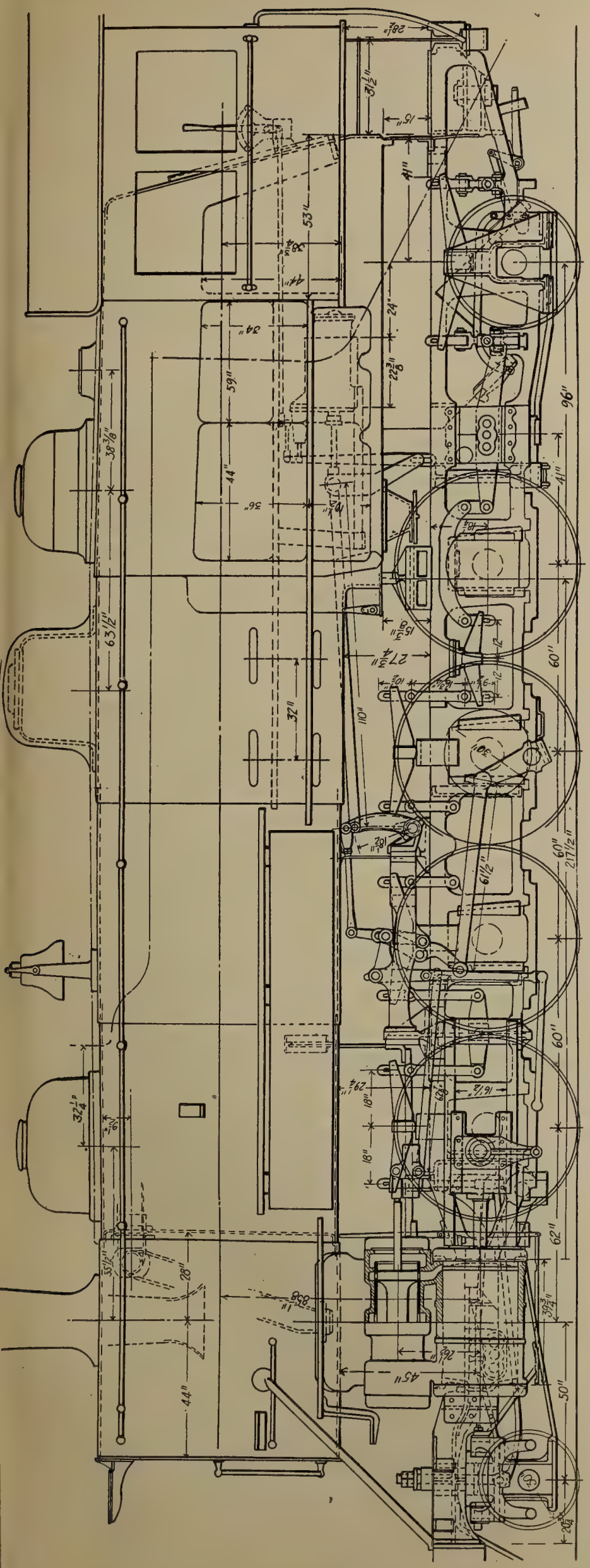
THE CENTRAL SAFETY COMMITTEE of the Chicago & North Western has been requested by S. Hirai, vice-president of Imperial Government Railways of Japan, for literature and information on the safety first movement, with a view to introducing a "safety first" campaign on the Japanese railways.

THE THIRD INTERNATIONAL Congress of Refrigeration will be held in Chicago in September, 1913.

The Chesapeake & Ohio, it is said, has entered into a contract with the Elkhorn Fuel Co. to build a 20-mile extension from Beaver Creek, Ky. The Elkhorn Fuel Co. was recently incorporated with a capitalization of $30,000,000 and has acquired about 300,000 acres of coal lands in Kentucky and West Virginia, to which this line will reach.

Press reports state that the extension of the Carolina, Clinchfield & Ohio to connect with the Chesapeake & Ohio at Elkhorn City is progressing rapidly. This work will cost about $6,000,000. As on previous construction work by this company expensive tunneling and grading is being done so as to permit the handling of heavy trains.

Reports state that the Nacozari has under advisement plans for extending its line about 100 miles south of Nacozari, Sonora, to aid in the development of mining property owned by Phelps, Dodge & Co.



Elevation of Mikado Locomotives, A. B. & A. R. R.

TESTS OF TENDER WHEELS.

A recent report from the Vandalia Railroad of the results of comparative service tests, extending over several years, of chrome-vanadium and carbon steel tender wheels shows that the chrome-vanadium wheels averaged 2½ times as much mileage per unit diameter of wear and turning, as those of carbon steel under the same class of tenders operating in similar service.

The tenders to which the wheels were applied were of 7,500 gallons water capacity and 12 tons coal capacity, with an average load per wheel on the rail of 17,875 pounds. They were operating in passenger service. A summary of the comparative results obtained up to June, 1912, after three and one-half years' service of the chrome-vanadium wheels is given in Table No. 1. It will be noticed that the chrome-vanadium wheels averaged 152 per cent more mileage per 1/16 in. diameter wear and turning than the carbon steel wheels.

Table 1—Summary of Comparative Tests of Chrome-Vanadium and Carbon Steel Tender Wheels.

	Chrome-vanadium tender wheels.	Carbon steel tender wheels.	Per cent in favor of chrome-vanadium wheels.
Coal capacity of tender (tons)...	12	12	...
Water capacity of tender (gals.)	7,500	7,500	...
Weight of tender in working order (pounds)	143,000	143,000	...
Average load per wheel on the rail (pounds).	17,875	17,875	...
Class of service	passenger	passenger	...
Average mileage per 1/16-in. diam. wear.	12,857	9,249	39
Average mileage per 1/16-in. diam. wear and turning.....	6,137	2,427	152
Maximum mileage per 1/16-in. diam. wear and turning.....	6,894	3,344	105
Minimum mileage per 1/16-in. diam. wear and turning.....	5,536	1,294	327

From analysis of the data obtained in these tests, the following conclusions were drawn as to the relative advantages of the chrome-vanadium wheels:

Great uniformity of material and greater mileage per unit diameter of wear. As a direct result of these, less flange wear and less material wasted in turning wheels in the lathe with consequent greater mileage per unit diameter of wear plus turning. An entire absence of shelled or burned spots in treads, which under the existing service conditions were found to occur in the carbon steel wheels.

Because of the extended period which they cover and the care exercised to insure accurate records, these tests are more than ordinarily conclusive as regards the particular conditions of service involved.

The records cover ten mated pairs of carbon and sixteen mated pairs of chrome-vanadium solid steel wheels. Records of twenty-six other chrome-vanadium tender wheels are now being kept by the above road. The tests herein given, were begun December, 1907, and between that time and December, 1908, records of the mileage wear and turning were kept of the ten mated 36 in. carbon solid steel tender truck wheels mentioned above. From January, 1909, similar records have been kept of the sixteen mated chrome-vanadium wheels.

Contour charts were made of each wheel before and after each turning. Comparison and analysis of the performance records in detail show that in these tests freedom from surface defects, shelling or burned spots on the tread, more uniform wear and reduction in flange wear, were the factors which resulted in the greatly increased mileage per unit of wear and turning secured from the chrome-vanadium wheels.

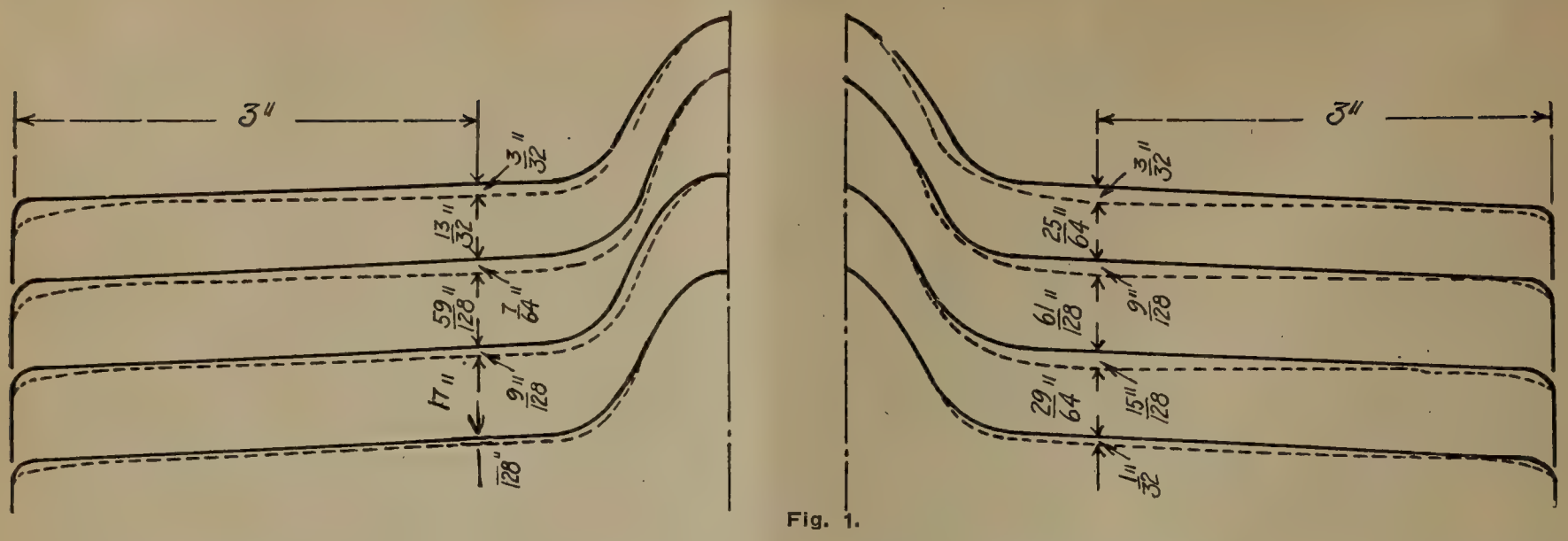


Fig. 1.

For example, carbon steel wheels 1,349 and 1,350, contour diagrams of which are shown in Fig. 1, gave a very good mileage per 1-16 in. diam. of wear, viz. 6801 and 7142 miles respectively. On the other hand, on account of these wheels shelling or being burned in the treads requiring the removal of a large amount of material at each turning, the average mileage per unit of wear and turning was very low, being only 1,294 and 1,329 miles respectively.

Similarly in the case of wheels Nos. 1365 and 1366, the former wore more rapidly than the latter, tending to cause increased flange wear. Both wheels were turned on account of treads shelling, consequently the mileage per unit of wear and turning was only 1,889 and 1,951 miles respectively.

In comparison, the mileage and wear of the chrome-vanadium wheels shows a greater uniformity of wear between the wheels of the various pairs and less loss of metal in turning. Thus the mileage per unit of wear plus turning averages about one-half the mileage per unit of wear only, while with the car on wheels the one is only one-fourth of the other.

Contour diagrams of mated wheels Nos. 1803 and 1804 shown in Figure 2 are typical of those of the chrome-vanadium wheels. These charts cover a period of service up to December, 1912, during which the wheels in question have made the remarkable record of 316,012 miles. They show a very uniform wear and freedom from flange wear. The average mileage per 1-16 in. diameter wear of the two wheels was 12,768 and 14,045 respectively, while the mileage per unit of wear plus turning was 5,962 and 6,019 miles. At the present time the chrome-vanadium wheels under observation have made over 300,000 miles, and it is reported that there is every probability of their reaching 400,000 miles. No surface defects, shelling or kindred troubles have developed in them during their entire service.

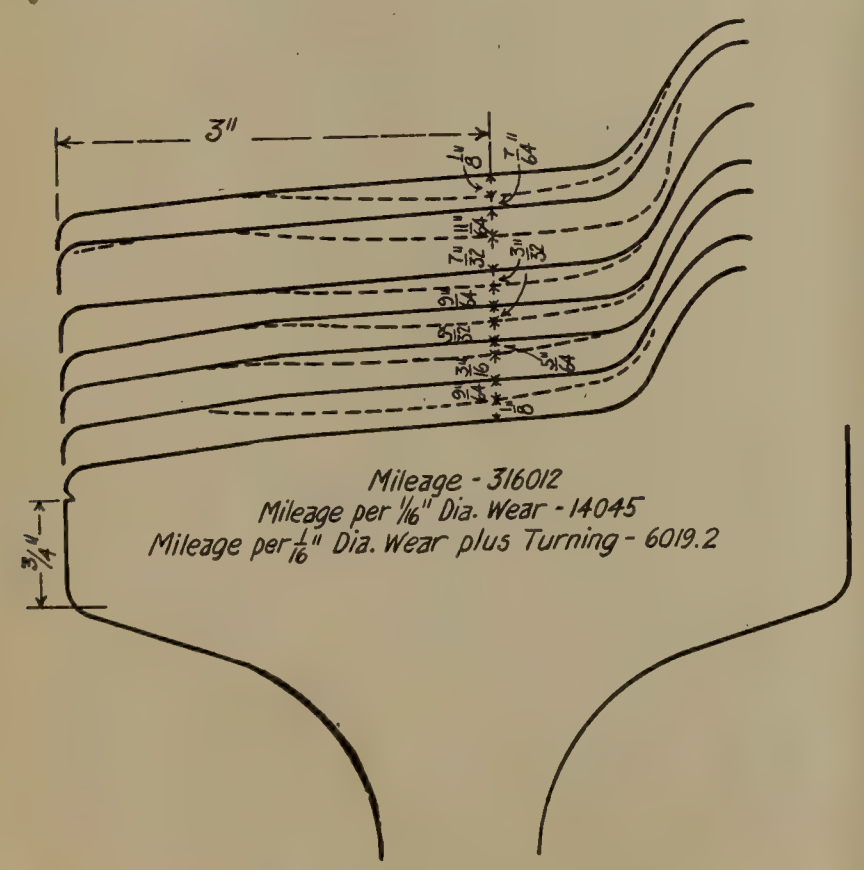


Fig. 2.

All contour diagrams were taken with a tire contour machine. The machine was attached to the wheel each time in the same center punch marks, two on the face and two on the back of the rim. Successive records for the same wheel were taken on the same chart. Thus, when completed, each chart shows the original and successive contours for each wear and each turning of the wheel.

It might be expected from the high physical properties of these wheels that some difficulty would be experienced in machining them after they had been in service and needed truing up. Such was not the case, however, as they were turned without difficulty in the truck wheel lathe at the speed of 17 ft. per minute.

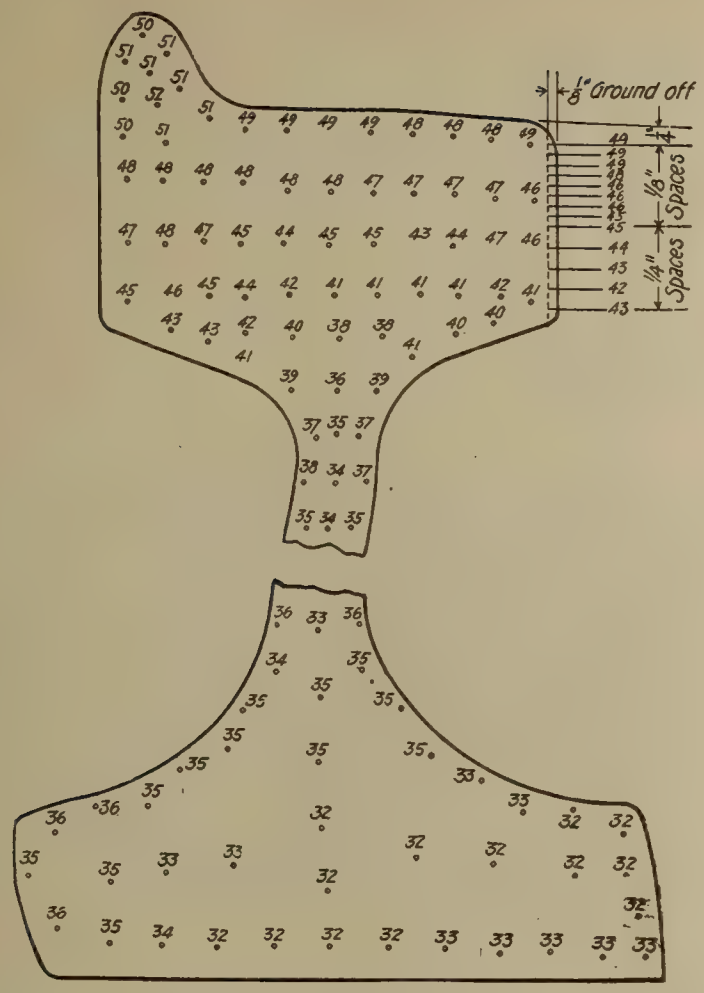
Last June a pair of these chrome-vanadium wheels which had then completed 258,000 miles were exhibited at the M. M. & M. C. B. conventions by the American Vanadium Co. Following the conventions, this set of wheels were cut up for test purposes and a series of physical and chemical tests were made.

Tests were made from pieces taken across the tread, in the web and in the hub. Hardness tests, both by the Brinnell and Scleroscope methods, were also made of cross sections taken across the entire wheel 120 degrees apart. The Scleroscope tests across the cross-section of the tread showed an average hardness of 45, with a corresponding average Brinnell hardness number of 293.

During the past few years exhaustive investigations have been conducted to determine the most satisfactory commercial method of heating chrome-vanadium wheels. These experiments have extended over a period of several years, during which a large number of tests have been made and the results with various methods of heat-treatment compared.

As a result of this research work a method of heat-treatment which has many advantages from the commercial standpoint, and gives a wheel of uniform physical properties, has been developed. This method consists of heating the wheel to a certain temperature, and then spinning it for a pre-determined time in a trough of water with the tread immersed to a little below the limit of wear line of the wheel. It is then taken out and allowed to cool in air, after which it is reheated for annealing.

By this method of heat-treatment the plate and hub are not effected by the immersion of the rim in water, but are really undergoing an annealing operation while the rim is being hardened. Figure 3 shows typical Scleroscope hardness tests obtained by this method.



Scleroscope Hardness Tests.

It will be noticed that a high and uniform Scleroscope hardness is obtained across the cross-section of the rim, which averages somewhat higher than 45, the average shown by the Vandalia wheels, which gave such high mileage, also that the hardness tapers gradually and uniformly to a softer metal in the plate and hub.

The chemical range of the wheels tested under the above method of heat-treatment was as follows:

Carbon	0.56 to 0.65%
Manganese	0.60 to 0.85%
Phosphorus	Under 0.04%
Sulphur	Under 0.04%
Silicon	Under 0.15%
Chromium	0.90 to 1.20%
Vanadium	0.18 to 0.24%

Results obtained from these investigations would indicate that the best wheel should show on the tread and on the face of the wheel a Scleroscope hardness of from 40 to 55. This would represent by a test across the tread of the wheel an elastic limit of around 35,000 to 90,000 pounds per square in. with an elongation in 2 in. of not less than 12½ per cent, and a reduction of area of not less than 40 per cent.

As a result of the rapid development of the past decade in the weight of locomotives, tenders and cars, and the higher speeds of modern freight and passenger service, the stresses and wear on tires and wheels have been greatly increased.

Tenders carrying 8,000 gallons of water and 14 tons of coal are now as common as those of 6,000 gallons and 10 tons capacity were but a few years ago. On roads where distances between water stations are long 9,000 and even 12,000-gallon tanks are quite extensively used.

In many cases of difficult through passenger service, where high speeds are maintained for protracted periods, the tenders now in use weigh practically as much as the locomotives employed six or seven years ago to handle the same traffic. Tender wheel loads have thus increased from around 14,000 pounds to 18,000 and 20,000 pounds per wheel and in some cases even higher.

On through passenger trains 75 and 80-ton steel cars are rapidly replacing the wooden car of 55 and 60-ton weight, and in fast limited service schedule speeds of 55 and 60 miles per hour are now maintained from terminal to terminal.

All these new conditions combine to impose increased duties on tender and car wheels. As a result the wear resisting qualities of the carbon steel wheel in general use are severely taxed.

In some cases, where extreme conditions of wheel loads and speeds obtain, the wearing action has reached a point beyond the physical properties of the carbon steel wheel to satisfactorily resist it. In consequence, rapid wear and shelling of wheels take place, resulting in greatly decreased mileage.

Truck wheels under heavy passenger cars and tenders are subjected to stresses as great or greater than any other parts of locomotive and car equipment when in regular service. Safety, the first requisite, and secondary only to that, the need of greater efficiency, demands the most careful consideration of the problem. The problem is not a new one; it is simply the same problem grown bigger.

The steel wheel was first introduced to meet special requirements which had exceeded the capacity of the chilled cast iron wheel. Then as these higher requirements became general, steel gradually replaced cast iron for passenger cars and tender wheels, until today the solid steel or steel tired wheel is the adopted standard for those classes of service. Similarly there is now need of a wheel of a higher grade or quality of metal in those cases where the carbon steel wheel fails to satisfactorily meet the requirements.

It is the general opinion of wheel experts, from exhaustive investigations which have been made of the subject, that the capacity of a wheel or tire to resist wear and shelling is governed by the elastic limit of the metal of which it is constructed. That is, when shelling or kindred troubles occur these can be greatly reduced or practically eliminated by the use of steel with a sufficiently high elastic limit and with other physical properties in proper ratio.

These higher physical properties can be obtained either by heat-treatment of the present standard carbon steel tire and wheel, or by the use of a heat-treated alloy steel. While heat-treatment improves the quality of carbon steel, it does not give as high physical properties as can be obtained in an alloy steel which is more responsive to heat-treatment.

Consequently, because of the high wearing qualities and dynamic strength of heat-treated vanadium steel, chrome-vanadium wheels and tires have been advocated as the most satisfactory solution of the problem in cases of excessive wear and shelling.

The conditions on the Vandalia are a case in point, and the records of the results obtained herein given would indicate that chrome-vanadium wheels offer the means of increasing wheel mileage where conditions have resulted in a great decrease in mileage secured from carbon steel wheels.

A SANITARY INSPECTOR has been appointed on the Chicago & North Western to carry on a thorough and systematic work in this line as a distinctive feature of its service. Clean and sanitary condition of trains is a feature which travelers greatly appreciate.

Application has been made in North Carolina for a charter, it is said, to build the Raleigh, Western & Atlantic from Bunn, N. C., southwest to Raleigh, thence northwest to Durham, about 50 miles. J. H. Pou, Raleigh, is interested.

It is stated that the Rio Grande & Eagle Pass contemplates constructing an extension from Laredo through the Rio Grande valley to a connection with a branch line of the St. Louis, Brownsville & Mexico, at Sam Fordyce, Tex. The extenison will be about 125 miles in length.

TWO-UNIT GAS-ELECTRIC TRAIN.

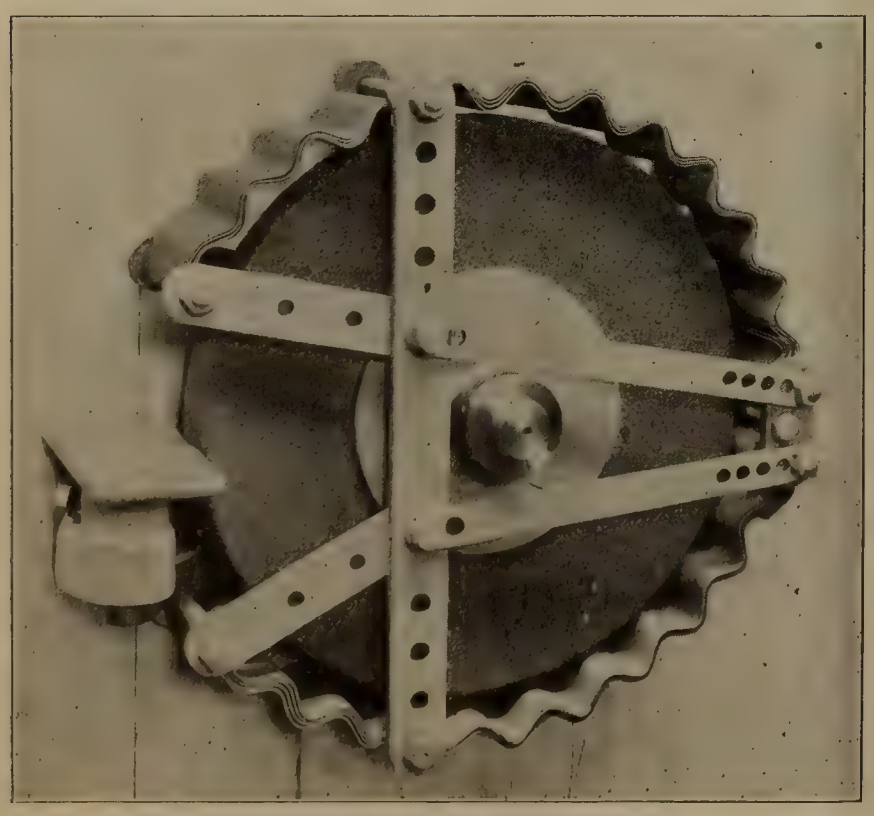
The accompanying illustration is an excellent view of the two-unit gas-electric train now in service on the Pittsburgh & Lake Erie between Pittsburgh, Pa., and College, half a mile west of Beaver Falls. The complete system of this division of the New York Central Lines extends from Youngstown in northeastern Ohio to Pittsburgh where it branches into two sections, one going to Brownsville and the other to Connellsville in southwestern Pennsylvania. The road handles an extensive freight business, its equipment consisting of 249 locomotives and 24,608 freight cars, in addition to 140 passenger and 468 miscellaneous cars.

The motor car is 42½ ft. long, 10 ft. 5 in. wide, weighs 36 tons and seats 42 people. It is partitioned into three compartments: one 20 ft. 5-in. long designed for a smoker, in which the seats are finished in Spanish leather; a small section for baggage 6 ft. long, as the traffic requirements do not call for the transportation of bulky express, and a cab 12 ft. long containing the power plant apparatus. It is equipped with a rear platform entrance. The trailer is 38 ft. long over the body, weighs 22 tons and seats 80 people, making a total seating capacity for 122 passengers. The seats are cushioned with friezette plush. Front and rear platform entrances are provided. Throughout the cars the

Two-Unit Gas-Electric Train, Pittsburgh & Lake Erie R. R.

The service of this gas-electric motor train is unique. It is the first instance where a self-propelled car of the type has been employed in this country on a main line heavy four-track road for local runs and interpolated between the schedules of limited trains. The motor car differs from the standard sizes heretofore developed by the General Electric Company. It is much shorter and is designed essentiálly for operation with a trailer. The seating capacity of the combination, however, is greater and equals the best ruling practice of interurban roads.

On the trial trip of the train from Pittsburgh to College, a distance of 31.2 miles, the out going run was made in 49 minutes, including three stops, at Coraopolis, Woodlawn and Aliquippa, respectively. Returning with two stops, the Pittsburgh station was reached in 42 minutes. Being equipped with motors of 200 total horsepower, the train is capable of averaging easily 50 miles per hour.



German Emery Wheel Guard.

interior trim is of mahogany, highly finished, and the decks are ceiled with composite board.

NOVEL EMERY WHEEL GUARD.

One of the most dangerous tools with which the machinist has to deal is the emery wheel on account of the high speed necessary for its successful operation and on account of the uncertainty that it will hold together under the required speed. Many accidents have occurred to workmen by the bursting of emery wheels.

Various forms of guards of heavy and strong construction have been devised, but the great force of one of these bursting emery wheels often breaks the guard, resulting in loss of life and property. The design and construction of a unique German elastic steel guard for emery wheels is shown in the accompanying illustration. This wheel guard is made up of bands of corrugated sheet steel .059 in. in thickness, several bands being held together by cross bars of framework bolted together in such a manner as to form an elastic guard, which is said to be very effective in gripping and holding the parts of a broken emery wheel and keeping them from flying. The emery wheels tested with this flexible guard ranged from 16 to 34 inches in diameter with speeds varying from 680 revolutions per minute to 1,650 revolutions per minute in breaking the wheel. This form of elastic emery wheel guard was designed and constructed at Hannover-Hinholz by the Vereinigten Schmirgel-Und Maschinen-Fabriken.

It is said that the Louisville & Nashville has plans for a new line from Calera south toward the gulf, which will reduce the distance between Birmingham and New Orleans nearly 50 miles. This project will probably not be undertaken, however, for some time.

The Beaver, Meade & Englewood has been organized to build a railway connecting Beaver, Meade and Englewood, Okla. The road as projected will be 75 miles long.

The Chesapeake & Ohio, it is reported, has let contracts and work is now under way, on a 7.9-mile extension up Island Creek, W. Va.

The Missouri Pacific will let contracts in the spring for widening 320 miles of present roadbed.

Inspection and Maintenance of Locomotive Boilers

By John F. Ensign, Chief Inspector, Division of Locomotive Boiler Inspection, Interstate Commerce Commission, Washington, D. C.*

Safety on railroads in a comprehensive sense must necessarily involve not only a discussion of the various legislative measures adopted by Congress and the general assemblies of the several states directed to that end, but as well the efforts which have been and are being made along the same lines by the various organizations, corporations and individuals, of which to a great extent the "safety" acts mentioned have been the outgrowth. Realizing the impossibility of covering a question of such magnitude in a paper of this kind, I will attempt only a brief outline of the origin and scope of some of the more important laws providing for the use of safety appliances on railroads, and will naturally discuss most freely the one for the enforcement of which I am directly responsible, the locomotive boiler inspection law.

To protect in the fullest possible measure the safety in life and limb of our fellow men, and particularly those whose employment on the great railroads, or in the mines and factories of the country, even under the most favorable conditions subjects them to more than the ordinary risk of injury, is, as it should be, one of the leading and most vital considerations now before the public.

To permit an accident to occur which might have been avoided by even the greatest possible precaution is to inflict an irreparable injury, not only to the unfortunate victim himself and his immediate family, but in many instances, aside from the question of liability for damages, to the employer himself, who is not infrequently deprived in this way of the services of a trained and efficient employee at a time when his services may be indispensable. In the third place there results a serious economic loss to the community and nation, as a study of the accident statistics for the past years will strikingly illustrate.

That there should have been delay on the part of employers in the adoption of safety appliances of the best known type until legislation requiring their use was enacted, and that even after such legislation was in operation there should have been difficulty in obtaining complete and cheerful compliance therewith, is a sad commentary on our twentieth century civilization. A study of the conditions attending and following the enactment of such legislation must clearly demonstrate that this has been the case. It is but natural that the demand for legislation of this character should have come from the employees upon whom, though least able to bear it, the burden of accidents due to the conditions complained of fall heaviest.

The question of properly safeguarding the lives and limbs of travelers and employees on railroads was first brought prominently before the public more than 25 years ago through the efforts of the railroad employees to obtain legislation compelling railroad companies to equip their cars and locomotives with automatic couplers, air brakes and certain other safety appliances. Innovations of this character received scant consideration in the early days of railroading. The rapid commercial development of the country, with its corresponding demand for increased transportation facilities, kept railroad men so busy meeting the demand that the question of safety of operation was, to a considerable extent, a side issue. The question of efficiency and sufficiency of equipment was the foremost consideration, and the employee was in the meanwhile expected to take care of himself. Injuries to employees were looked upon as part of the day's work; and when suits for damages were brought, the decisions of courts in passing upon such cases were usually based upon the common law doctrine of "assumed risk," under which the employee was held to have assumed all of the ordinary and apparent risks incident to his employment.

The wonderful growth of the railroad business, with its accompanying demand for increase in size of cars and locomotives and in the weight and speed of trains, finally increased the hazard of railroad employment to such an extent that the adoption of improved and additional safety appliances became a matter of pressing necessity. It was at this stage that the employees, finding appeals to the railroad companies unavailing, turned to Congress; and, after several years of effort and in the face of vigorous opposition from the railroads, succeeded in obtaining on March 2, 1893, the passage of a law entitled, "An act to promote the safety of employees and travelers on railroads by compelling common carriers engaged in interstate commerce to equip their cars with automatic couplers and air brakes, and their locomotives with driving wheel brakes."

That there should have been organized and vigorous opposition to a law so manifestly for the interest of all concerned seems almost incredible to us at this time; but it must be remembered that while all brakes and automatic couplers were even then past the experimental stage and fairly met the demands of the service at that time, they had not reached that high degree of efficiency to which they have since attained, and consequently many railroad officials had little faith in them. Then, too, it must be borne in mind that railroad men are naturally conservative, and a great many were inclined to take the position that devices and practices which were sufficient in the past were ample for the present; hence a change, particularly one which involved the expenditure of considerable money, was not favored.

While the safety appliance law was a big step forward, its limited scope left much to be desired; and accordingly, as experience has from time to time shown the need, additional acts have been passed enlarging and improving upon the original law.

The law requiring the proper inspection and repair of locomotive boilers and their appurtenances is of such recent origin, and in its application has been so freely discussed, that all mechanical men should be reasonably conversant with its provisions. Some of the members of this club were on the committee representing the railroads when the boiler inspection rules were being prepared. It is perhaps not unnatural that in the interpretation of the law there should, as is usually the case, be some diversity of opinion as to just what it requires, and the proper method of complying with its terms; therefore, in the hope that a more uniform understanding of what we believe is required may be brought about, I shall speak of some of the questions that have come up since the law became effective.

The most frequent objection encountered with regard to our method of inspection has been that defects not at the time considered in distinct violation of the law are reported, resulting in mechanical officers being frequently asked by managers to explain why such defects were permitted. It seems to me that those who raise this objection must do so without giv-

*A paper delivered before the St. Louis Railway club.

ing the matter very careful thought. The obvious purpose of this legislation has been to promote safety, not to collect penalties; although the penalty must also have been provided for, as otherwise the law might be ignored.

We have endeavored, however, and in a majority of instances with very gratifying success, to obviate the necessity of bringing suits to collect penalties, and this to a great extent has been accomplished by the practice of reporting all defective conditions as found, so that remedies might be applied before these same defects developed to such a degree as to become dangerous enough to amount to a positive infringement of the express enactments of Congress.

This policy, it is true, can only be successfully followed in cases where there exists a sincere desire to better conditions, and an honest effort is being made by officials to comply with the requirements and the spirit of the law. Where attempts are made to place the entire burden of inspection upon the Government by neglecting defective conditions until attention may be called to them by a Federal inspector, an entirely different course will have to be pursued, as the law did not contemplate, nor provide a sufficient number of inspectors for the Government to do this work alone.

Section six of the law provides that:

"The first duty of the district inspector shall be to see that *the carriers* shall make inspections in accordance with the rules and regulations established or approved by the Interstate Commerce Commission, and that the carriers *repair the defects* which such inspections disclose before the boiler or boilers, or appurtenances pertaining thereto, are again put in service."

It is evident from this requirement that the principal duties of the Government inspector should be of a supervisory nature, and that it was the intention of Congress to place the burden of making thorough inspections and the responsibility for the condition of all locomotives in service entirely upon the carriers.

The law further provides that the district inspector "shall make such personal inspections of locomotive boilers under his care as may be necessary to fully carry out the provisions of this act, and as may be consistent with his other duties," and this is the course which is being pursued.

Where attempts are made by any railroad to shift the burden of inspection upon the Government by continuing defective equipment in service until the defects are discovered and ordered repaired by a Government inspector, it will be necessary to resort to section nine of the law, which provides a penalty to cover three distinct forms of violation:

First, for violation the law itself;

Second, for violating any rule or regulation made under its provisions; and

Third, for violating a lawful order of any inspector.

Under these provisions it is manifest that railroads are to be held just as liable to penalty for permitting the operation of a locomotive in a condition contrary to the law's requirements, although such defects may not have before come to the notice of a district inspector, as they would be were they to operate a locomotive after its having been ordered from service by an inspector. Congress recognized the fact that it would be impossible for 50 inspectors to at all times keep in touch with the condition of each of the 65,000 locomotives in service; and accordingly the responsibility for the making of proper inspections, prompt repairs, and for the general condition of equipment was placed primarily on the carriers, and a penalty provided in case of their failure to meet the requirements, regardless of whether a district inspector may have previously notified them of the existence of the defective condition or not.

Of the rules concerning which there has been evident misunderstanding in some cases are rules 45 to 48, governing the washing of boilers. On some roads where water conditions

Boiler Explosion Due to Defective Dome.

are such that it is necessary to wash boilers more frequently than the minimum of once a month required by the rules, it seems to have become a practice to remove all the washout plugs but once each month, allowing some of the plugs to remain and giving only a partial washout on the other occasions. This is not in accordance with the rules. Rule 45 requires boilers to be thoroughly washed as often as water conditions require, but not less frequently than once each month; and rule 46 provides that when boilers are washed, *all* washout, arch and water bar plugs must be removed. We do not consider that this applies to a water change, when only the washout plugs in the water-legs are removed to facilitate emptying the boiler. But where a hose is used to wash sediment out of the boiler, and, perhaps, other washout plugs are removed, crown sheet rinsed, or the barrel of the boiler partially washed, we consider it a washout, and all plugs should be removed and the boiler thoroughly washed as required. All we are asking in this respect is a reasonable and fair compliance with the plain requirements of the law. Roads which are indulging in what might be termed "sharp practice" in this respect, some of which I could name, are only deceiving themselves, and will eventually find it would have been to their advantage in many ways to have kept their equipment in such condition as to meet all the requirements of the law.

Rule 50 is another apparent source of some misunderstanding, or at least is not being properly observed by many carriers. This rule provides that

"All steam valves, cocks and joints, studs, bolts and seams shall be kept in such repair that they will not emit steam in front of the enginemen so as to obscure their vision."

We believe this provision covers every point where steam leaks may occur. The object of this rule is to insure to the enginemen a reasonably clear view of the tracks and signals. We have found that in many instances no inspection of the locomotive while under steam is made by the railroad's inspector. This naturally is the only time when he would be able to determine whether steam leaks exist or not; but still his report certifies that all steam leaks have been repaired. Inasmuch as the United States statutes provide a very severe penalty for a false certification on a report of this kind, this places the railroad inspectors in a very undesirable position. The law requires a sworn report of each inspection, and of the repairs made as a result of the inspection, and as the inspector is responsible under the law for the correctness of the statements that he certifies to, the report should show conditions exactly as he finds them.

It is not a proper compliance with the law, neither is it fair to the railroad inspector, that he be required to certify to a report for the Government showing everything in good con-

dition, and at the same time be required to make out a different report for the railroad company, showing firebox sheets and flues "fair," "poor," or "bad," as the case may be; yet we know of cases where this has been done.

Another point, the importance of which we believe is not fully realized, is the responsibility of the man who signs reports as officer-in-charge. Rule 7 provides that:

"The mechanical officer in charge at each point where boiler work is done will be held responsible for the inspection and repair of all locomotive boilers and their appurtenances under his jurisdiction. He must *know* that all defects disclosed by any inspection are properly repaired before the locomotive is returned to service."

The officer-in-charge is required to sign the following certification:

"I hereby certify that to the best of my knowledge and belief the above report is correct."

The rule above quoted, requiring positive knowledge on the part of the officer so certifying that all defects disclosed by the inspection to which he certifies have been repaired before locomotive is returned to service, places even greater responsibility on him than on the inspector; because, in addition to knowing that the inspection and repairs have been made, he must also know that the report is correct. For this reason the officer-in-charge at points where inspections are made should give more of his time and attention to this work than is frequently the case at present.

The proper care and adjustment of safety valves is another matter which does not always receive the attention that it should. Rule 34 provides that—

"Every boiler shall be equipped with at least two safety valves, the capacity of which shall be sufficient to prevent, under any conditions of service, an accumulation of pressure more than 5 per cent above the allowed steam pressure."

This rule does not mean that the Government shall design the safety valves, prescribe what make they shall be, or anything of that kind. It simply fixes a minimum capacity below which you shall not go. When it has been demonstrated by test that the boiler can generate steam faster than the safety valves can take care of, we have asked, and will continue to insist, that the capacity of the safety valves be increased to meet the requirements of the rule. If the capacity of the valves has been decreased by lack of attention, or improper repairs, proper attention should be given them; if their capacity was originally insufficient, the remedy is obvious and should be applied. Of the first 50 locomotives on which a safety valve test was made by us 58 per cent had safety valves which would not relieve the pressure in accordance with Rule 34. Immediate steps were taken, however, to remedy this condition and a material improvement has resulted, although there is need for still further improvement in this direction.

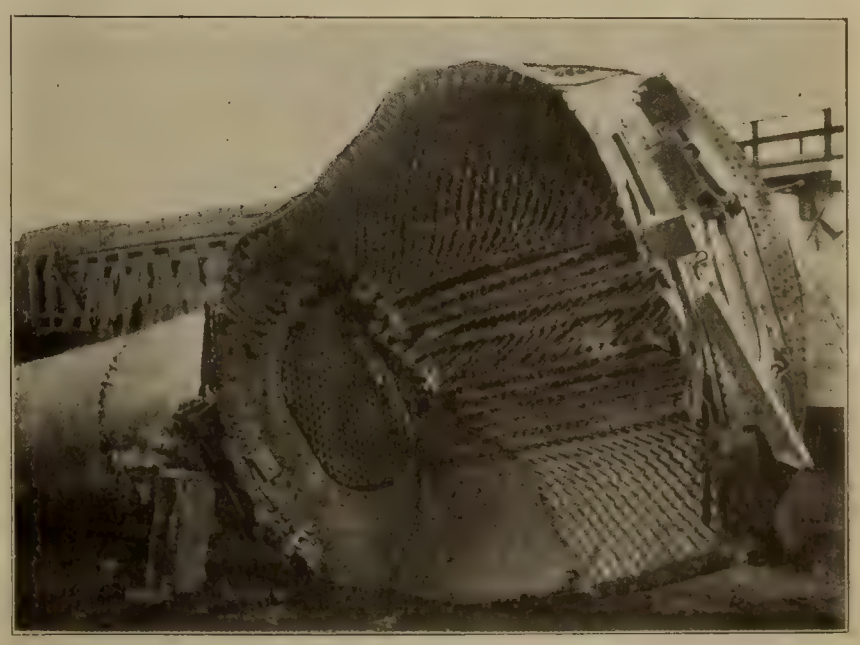
A general resume of the work done by the Division of Locomotive Boiler Inspection during the fiscal year which ended July 1, 1912, is given in the annual report recently issued, an examination of which will, we believe, show the accuracy of the conclusions reached by the writer of this article. This report contains a complete list of all accidents that occurred during the year, briefly stating the cause, so far as it could be determined at the time of the investigation. When investigating accidents inspectors are instructed to take nothing for granted, and to make no statements which are not borne out by facts disclosed at the investigation. Our only object is to discover the cause of the accident, and then take the proper steps to prevent, if possible, similar accidents in the future Where any indication of weakness in construction or defective material is found, tests are made to determine positively if such conditions exist. The total number of accidents due to the failure of locomotive boilers or their appurtenances during the year was 856, in which 91 persons were killed and 1,005 persons injured. Many of these accidents, in fact a majority of them, were of a minor character, which formerly would have caused very little comment, but which proper attention to equipment would absolutely have prevented. With this idea in view they have been investigated, the cause determined and reported, and steps taken to prevent a recurrence of such accidents. In cases where a road might have had an epidemic of minor accidents of a certain character, investigation invariably disclosed the fact that they were due to improper equipment being used, or to neglect in repairing small defects. In such cases the proper remedy was recommended and applied. An analysis of the accident records show that 29.6 per cent of the deaths and 4 per cent of the injuries were due to boiler shell explosions caused either by overpressure or defective boiler shells. 38.4 per cent of the deaths and 12.8 per cent of the injuries were caused by crown sheet failures, due to overheating, for which no contributing cause could be found. 20.8 per cent of the deaths and 3.9 per cent of the injuries were caused by crown sheet failures for which contributing defects, or defects which may have caused the accident, were found. 11.2 per cent of the deaths and 79.3 per cent of the injuries were due to other defects, including defective appurtenances.

In order that no misunderstanding could possibly arise, each accident was listed under the name of the road on which it occurred, arranged alphabetically.

The report shows that during the year 74,234 locomotives were inspected, of which 48,768 were found defective. This does not mean that 48,768 locomotives were found which did not meet the requirements of the law; because in that case the inspectors would have had to serve a written order to hold them out of service for repairs, as the law allows no discretion in the matter. It does mean, however, that under the policy which we have adopted, and which we expect to continue, of inspectors reporting defects and endeavoring to have them repaired before they cause an injury, or subject the company to the liability of a penalty, that these locomotives contained defects which should have been repaired before they were placed in service.

The next item in the report shows that 3,377 locomotives were ordered out of service for repairs, and this represents the number found with defects which were in violation of the law. In addition to this the pressure was reduced on 699 locomotives and seams were reinforced by welt plates on 327 locomotives to insure a proper factor of safety. Six hundred and ninety-eight were permanently removed from service on account of defective condition. On 992 the water glass was raised, and on 408 the lowest gauge cock was raised to meet the requirements of the law; 351 required the application of braces of greater sectional area, and 116 required additional support for the crown sheet.

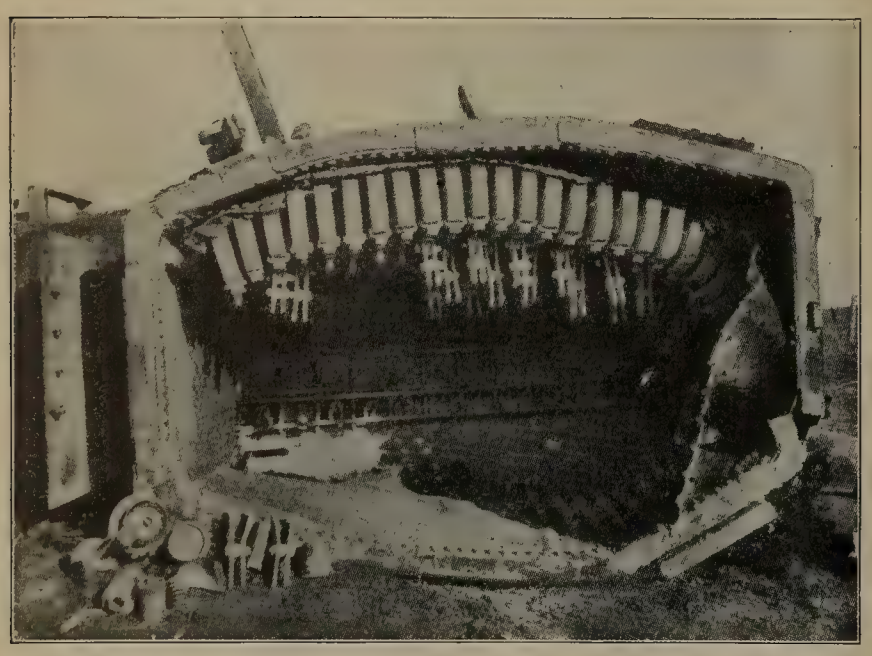
It will thus be seen that a total of 6,968 locomotives, which



Explosion of Wooten Boiler Due to Low Water.

is more than 10 per cent of the total owned, were either held out of service for repairs or changed and strengthened to conform with the requirements of the law. There is a distinction made in the report between defects which are in violation of the law and the defects which are reported in our efforts to prevent violations. In order to prevent any misconstruction, except a wilful one, being placed on it, each defect is tabulated so that anyone can determine the exact number and nature of defects reported by district inspectors on any railroad.

What James J. Hill says of terminals, or rather the lack of terminal facilities for cars, applies with even greater force to terminals and proper accommodations for the housing and care of locomotives. Many of the complaints which are heard regarding "car shortage" should be more properly chargeable to locomotive shortage. There are many places where locomotives are taken care of out-of-doors through the lack of roundhouse, shop or other accommodations for either men or material. Boilers are supposed to be washed and work done on engines at such points, often when the thermometer registers below zero, which we, as railroad men, know is an utter impossibility. At all division points where trains are to be made up, every facility necessary for the proper care of locomotives should be in-



Explosion Due to Defective Bracing of Crown Sheet.

stalled. It does not matter how costly are the terminals, how capable the railroad officials, nor to what degree of proficiency the employees may have attained, if the locomotives are not kept up to such a standard that they can be operated at their greatest degree of efficiency, the railroad is not earning a maximum return on its investment, owing to the disadvantage under which it labors in the operation of wornout or improperly repaired locomotives.

During the last year large sums have been expended toward bringing the locomotive to a higher standard of efficiency. Especially is this true in the case of what is known as the superheater; the application of which is undoubtedly productive of excellent results, when properly maintained, by reason of the economy thereby effected in steam consumption. Yet, it is an almost daily sight to witness a locomotive leaking steam from pistons, valve stems, cylinder saddles and other appurtenances sufficient almost to operate the machine, if it were being properly utilized; this entirely aside from the danger of collisions likely to result from the obstructing of the enginemen's vision.

A statement of tons carried in 1893 as compared with tons carried in 1911 will illustrate the growth of the locomotive more than I could do along other lines in an hour.

In 1893 the number of tons carried on the railroads of the United States was 745,119,482; in 1911 the number was 1,781,638,043, an increase over 1893 of 1,036,518,561 tons. The number of tons carried one mile was 93,588,111,833 in 1893, as against 253,783,701,839 in 1911, an increase of 160,195,590,006 ton miles. With this increase in traffic came a relative decrease in the number of men directly employed to handle it. The number of trainmen employed by the railroads in the United States in 1893 was 146,544, and in 1911 it was 221,426. The average number of tons in a train in 1893 was 184; this had increased to 383 in 1911, or more than 100 per cent. The number of tons carried for each trainman employed in 1893 was 5,085; in 1911 it was 8,046, an increase of 2,961 tons per man. The number of tons carried one mile for each trainman employed increased from 638,635 in 1893 to 1,146,133 in 1911. This increase was effected notwithstanding there was a decrease in the number of train miles run for each trainman employed, the figures being 5,764 in 1893 and 5,589 in 1911.

These facts appear in tabular form as follows:

	1893	1911
Number of tons carried.....	745,119,482	1,781,638,043
Number of tons carried one mile..	93,588,111,833	253,783,701,839
Average number of tons in train..	184	383
Number of trainmen employed...	146,544	221,426
Number of tons carried for each trainman employed	5,085	8,046
Number of tons carried one mile for each trainman employed....	638,635	1,146,133
Number of train miles run for each trainman employed	5,764	5,589

The points which I have discussed tonight have not been brought out with a desire on my part to magnify the importance of the work which is being done by the Department of the Government with which I am connected, nor with a desire to unjustly criticise the condition of railroad equipment or the work of the railroad officials who are in charge of such equipment. Every question relative to locomotive boiler inspection which has been touched upon has come up in the regular course of our work and information has been frequently requested relative thereto. Our policy has been to freely and frankly discuss matters of this kind with railroad officials in order to bring about a better understanding of what we believe the law requires, to the end that the desired improvement may be brought about without the necessity of resorting to the courts. In this course we have met with gratifying success, due in large measure to the co-operation we have received from a large majority of the railroad officials of the country.

It is, of course, impossible for us to meet and personally discuss these matters with every railroad official who has charge of such work, and I have accordingly taken the opportunity of discussing them here for the benefit of all. If what has been said has been the means of clearing up any doubtful points for anyone and thus bringing about a change in any improper practices which may have existed in the past, or will be the means of encouraging co-operation to a greater degree in the future, I shall feel that much has been accomplished.

It's just a big business proposition; something for all of us to do, and if through our combined efforts we keep some fellow citizen from personal injury or death, we have done something worth while. If we can collectively be the means of saving some fellow citizen's life or limb I feel that we will have accomplished much.

The Richmond, Washington & Chesapeake is said to have awarded contract to Lane Bros. of Altavista, Va., to build the line from Doswell to Sandy Point, Va., about 82 miles. Price reported is $1,400,000 and work is to begin as soon as men and materials can be assembled.

The Twin Falls, Oakland & San Francisco which has been organized at Twin Falls, Idaho, proposes to construct a line from Twin Falls to Wells, Nev., which is on the Southern Pacific and also on the Western Pacific.

SLEEPING CARS, CANADIAN PACIFIC RY.

The illustrations show one of a lot of thirty new sleeping cars being built for the Canadian Pacific by the Barney & Smith Car Co. These cars have a total length of 72 feet 8 inches over end sills, a total width of 9 feet 10½ inches over side sills, with a height over all, from top of rail of 14 feet 5 5/16 inches. The entire design of framing as followed out is strictly in accordance with the standard as adopted by the Canadian Pacific, being wood throughout, with the exception of the end framing, which consists of six wrought iron end posts 3 feet by ⅝ inch, with ends turned at right angles and securely fastened to the end sills and end plates with 3 by 3 by ⅝ inch corner angles. The needle beams are rolled steel 5 inch by 8 inch buld tee irons, 20.2 lb. per ft. The outside sheathing is 13/16-inch mahogany.

The inside finish is of the very best grade of Cuban mahogany throughout, with marquetry design of the Chipendale style, with the exception of the smoking room, which is of English oak with marquetry design. The ceiling is of ¼-in.

Interior of New Sleepers for Canadian Pacific.

Agasote, canvas-faced, throughout the car, decorated in colors.

The section seats and sofas in the main and state rooms are upholstered in green frieze plush, while the sofas and chairs in the ladies' toilet and gentlemen's smoking room are upholstered in Spanish leather.

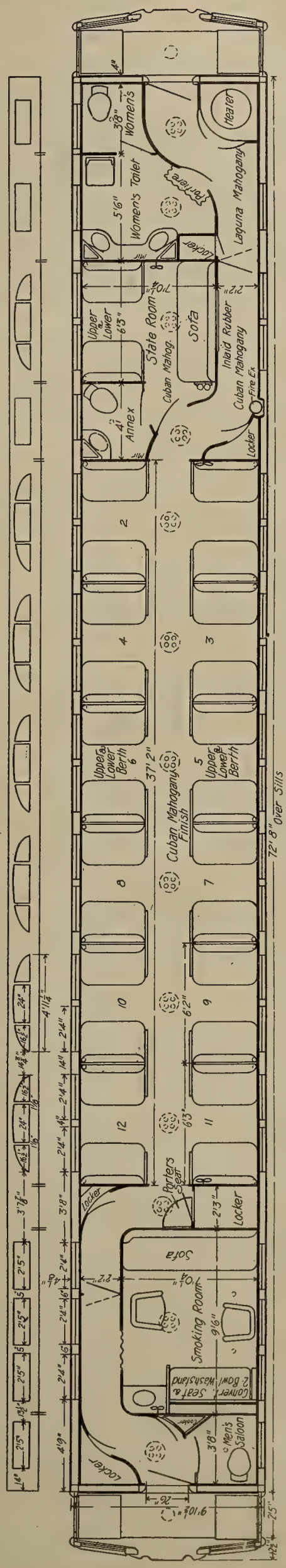
Particular attention has been paid to the lighting equipment of these cars, which is the Stone system, furnished by J. Stone & Company. It is their type, D. Z., 24 volt, axle light, with 24 cells of Stone batteries, arranged in parallel of 12 cells each.

The upper berth lamps of these cars are of the latest design with automatic cut-out switches, which shut off the current as the bunk is closed up.

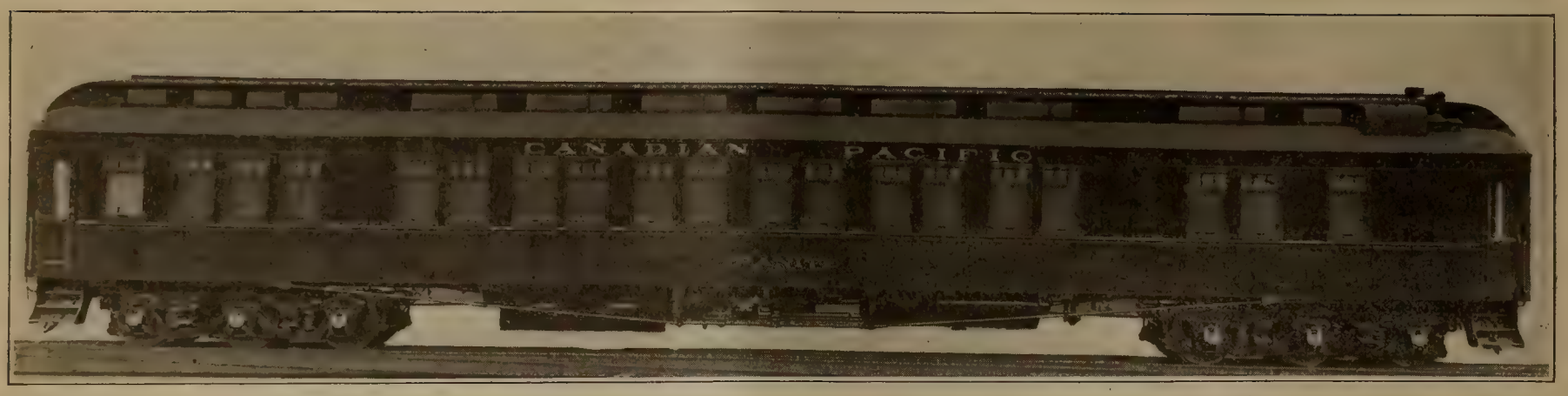
The heating arrangement in these cars is the Gold duplex system of hot water circulation, with Frumweiler heater, controlled by the Canadian Pacific standard heat controller.

The air brake arrangement as applied is the Westinghouse Air Brake Company's schedule L. N. 1612, with handbrake arrangement co-operating with same, and operating from both ends of the car.

The trucks are of special design built-up steel 6 ft. 10¼



Plan of New Sleeping Cars for Canadian Pacific Ry.



New Sleeping Cars, Canadian Pacific Ry.

in. wide with 11 ft. 0 in. wheel base, of 80,000 pounds capacity, with 36¼ in. cast steel wheels equipped with Krupp steel tires, 5 in. by 9 in. journals, Simplex brake beams, American Brake Shoe & Foundry Company's cast steel back brake shoes, McCord journal boxes and Susemihl side bearings.

As a whole, these cars embody all of the latest designs and appliances known to the car-building art, being of most modern construction, presenting a beautiful appearance and affording most comfortable conveniences to the traffic-riding public.

EXECUTIVE COMMITTEE MEETING, C. I. C. I. & C. F. ASSN.

An executive committee meeting of the Chief Interchange Car Inspectors' and Car Foremans' Association, was held at the Karpen Bldg., Chicago, Ill., at 10 a. m., on February 21st, 1913. Mr. Trapnell having been delayed, the morning session was presided over by president Stark. Chairman Trapnell arrived in time, however, to preside over the afternoon session. A large number of visitors were present and on motion, they were given the privilege of the floor. The following committee members and visitors were present:

H. Boutet, C. I. I., Cincinnati; T. M. Baugham, C. G. W., Oelwein, Ia.; Geo. Butler, Car Foreman, C. I. & L.; Chas. Bossert, Asst., C. I. I., Chicago; I. N. Clark, C. C. I. B., Chicago; M. F. Covert, Asst. M. C. B., S. R. T. L., Chicago; E. J. Constant, Asst. I. I., Chicago; J. P. Carney, F. C. D., M. C. R. R., Chicago; E. R. Campbell, G. C. F., St. Paul, Minn.; A. S. Cook, C. & A., Chicago; John Dixey, M. C. B., D. S. D., Chicago; W. E. Farnum, C. & E. I., Danville, Ill.; R. E. Forbes, Asst. I. I., Chicago; H. W. Gardner, L. S. & M. S., Chicago; H. C. Gillispie, M. M., C. & O. of Ind., Peru, Ind.; F. H. Hanson, L. S. & M. S., Cleveland; H. H. Harvey, C. B. & Q., Chicago; J. L. Hodgson, M. C. B., Grand T., Port Huron, Mich.; C. C. Hewitt, N. Y. C. & H. R., Buffalo; O. P. Hittabiddle, Wabash; A. Johnson, N. Y. C. & St. L., Chicago; L. J. Koppen, M. M., C. & I. W., Chicago; A. Kipp, N. Y. O. & W., Middletown, N. Y.; C. D. Mitten, A. C. L., Chicago; O. Moser, G. A. C. L., East Chicago; H. F. Maxwell, C. & N. W., Chicago; O. W. Middleton, Editor, *Railway Master Mechanic,* Chicago; F. Mathews, C. C. I. B., Chicago; J. McNally, G. A. C. L., East Chicago; H. Nightingale, Grand T., Chicago; C. Nordquist, Erie, Chicago; A. K. Plumber, G. C. F., C. B. & Q., Chicago; A. F. Petersen, M. C. B., C. B. T. Co., Chicago; H. G. Powell, C. R. L., East Chicago; C. S. Roof, G. C. F., C. T. H. & S.-E., Terre Haute, Ind.; C. V. Ratcliff, G. C. I., C. & O. Covington, Ky.; J. L. Stark, Chicago; W. J. Stoll, C. I. I., Toledo, Ohio; S. Skidmore, C. C. C. & St. L., Cincinati; S. Shannon, Chicago; F. C. Schultz, C. I. I., Chicago; A. E. Schultz, Asst. I. I., Chicago; F. W. Trapnell, C. I. I., Kansas City, Mo.; J. E. Vittum, C. I. I., Columbus, Ohio; C. J. Wymer, Belt Ry., Chicago; W. G. Willcoxson, Chicago; J. F. Wright, Chicago; C. Zorn, G. C. I., Soo Line, Stevens Point, Wis.

It was decided to hold the next annual convention at Minneapolis on August 26, 27 and 28. Messrs. Stark, Schultz and Campbell were appointed as a sub-committee to work out the details. Messrs. Skidmore, Stoll and Hanson were appointed a committee on Constitution.

The changes in the M. C. B. rules recommended by the executive committee are as follows:

Recommended Changes in M. C. B. Rules.

Rule 1.

The addition of the words "and repairs" to be added after the words "adjusting brakes."

Rule 2.

First paragraph changed to read "cars having defects for which car owner is not responsible must be properly carded at the time of interchange, preferably by the receiving line."

Paragraphs A and B.

Change to read: "Cars (whether loaded or empty) having defects in the violation of the safety appliance acts and leaking tank cars containing inflamable liquid must be repaired or transferred without any unnecessary movement, or at the nearest available repair track. Also cars loaded with explosives shall be handled in accordance with the regulations of the Interstate Commerce Commission."

Paragraph C.

Add the word "originally" after "cars," making it read "cars originally improperly loaded."

Paragraphs D. & E.

These paragraphs to be eliminated from the rules.

Rule 7.

Omit applying the repair card to a car under any circumstances.

Rule 8.

Change wording to read "made in duplicate" to conform with change in rule 7. Also change to read: "the billing repair cards shall be printed on white paper."

Rule 9.

First six items changed to read as follows:

M. C. B. couplers, or parts thereof, R. and R.
- New or second hand.
- Size of shank.
- Yoke, stem or key attachment.

Wheels and axles, R. and R.
- Cast-iron, cast-steel, rolled or forged steel or steel-tired wheels.
- New or second hand.
- Cause of removal (see Rule 10).
- Trucks: Solid pedestal or arch bar type.

Journal bearings, R. and R.
- Solid, filled or other kind.
- Length of bearings applied.
- Box number (see Rule 14).

Metal Brake beams, or parts thereof, R. and R.
- Make or name of beam.
- New or second hand.

Complete, or part or parts.
Part or parts scrapped.
Brake shoes, applied.
Cast or reinforced back.
Tripe valve, R. and R.
Maker's name and size.

Rule 14.

Suggested that a diagram be given showing defects upon body of car as well as upon trucks. The omission of the words "repair card" to conform with Rule 7.

Rule 17.

Railroads making the repairs should be permitted to put on any good substantial outside metal roof in lieu of the original roof on cars of 80,000 lbs. capacity or over.

Rule 21.

Changed to read "Bills may be rendered against car owners for the cost of applying temporary running boards and hand rails to cars originally equipped with roofs or running boards to make safe such cars for trainmen when repairs are chargeable to car owners, except in the case of wrecked cars."

Rule 32.

The sub-committee appointed to adopt a new wording for this rule reported as follows: "Damage of any kind requiring repairs or renewal if due to unfair usuage, derailment or accident. Defect card shall not be required for raked sides, sheathing, side doors and attachments, corner bands, side fascia or roofing on house cars when damage does not require repair or renewal of side plate, side sill, corner post, intermediate or side post; nor for sides, corner bands, side stakes or stake pockets on open cars, or outside framed house cars, when not requiring repairs or renewals to more than three stakes; posts or braces; also damaged ends, end doors, end plates, end fascia or end sill and damage is from outside and does not exceed combination mentioned in rule 42. This paragraph does not apply to cars of private ownership."

Rules 37, 38, 39 and 40.

Eliminate these rules.

Rule 42.

Eliminate last three paragraphs.

Rule 43.

Last paragraph changed to read "when repairs exceed the combinations as covered by rules 41 and 42, owner's authority must be obtained before repairs are made."

Rule 49.

Moved that the word "repair" be stricken out.

Rule 58.

Suggested that the time for holding delivering line responsible be extended for at least two years.

Rule 68.

Change to read: "Flat sliding" in cast iron wheels if spot caused by sliding is 2½ in. or over, except in case of one pair of slid flat wheels where one wheel is slid 2½ in. and mate wheel two inches or over, defect card to be issued for one pair of slid flat wheels."

Rule 69.

Change to read: "Broken flange except as in rule 78, chip flange when chip exceeds 1½ in. in length and ½ in. in width, broken rim if thread measured from flange at a point 5/8 in. above thread is less than 3¾ in. (see Fig. 5) if caused by derailment or accident."

Rule 82.

Omit reference to the throat of the flange.

Rule 90.

Omit reference to repair cards.

Rule 93.

A limit should be set upon the time in which bills can be presented on repair cards.

Rule 104.

Attention called to credit allowances on non-M. C. B. standard brake beams.

Rule 115.

Changed to read: "When body of a car is destroyed and company destroying it elects to return the trucks, they shall be put in good order or accompanied by a defect card covering all defects or improper repairs made by them for which the owners are not responsible, and forwarded within 60 days, free of freight or other charges, to the nearest point on the line of the company owning or operating the car, and the number, line and class of car destroyed shall be stenciled or painted on each truck so returned."

Cut out the word "axles," in the second paragraph.

Rule 120.

Substitute the following: "A car unsafe to load on account of general worn out condition, shall be inspected by representatives of the reporting line and a representative of a disinterested line, who shall make report in triplicate, the original to be forwarded to the car owner, and one copy to be retained by the reporting line, and one by the representative of the disinterested line. This report shall give in detail the defects found upon the car. Upon receipt of this information, the owner of the car shall authorize the reporting line to either make repairs or destroy the car at the owner's expense, allowing the proper credit. Per diem to cease from date of inspection."

Rule 121.

The following rule substituted: "A car which is safe to run, but unsafe to load on account of serious damage caused by wreck or accident, may be billed home direct to the owner, on revenue billing, charges prepaid, by the shortest route properly carded for all delivering line defects."

Mr. Schultz suggested the change in rule 1 in order to compel the handling line to give the same attention to repairs to foreign cars on its line that it gives its own cars. He suggested the change in paragraph 1 of rule 2, as the present rule does not indicate what company should apply the defect card. The change in paragraph C is to correct the rule so as to apply only to cars originally improperly loaded.

Mr. Harvey suggested the change in rule 7 stating that the repair card was of no use to anybody on the car, and was only an unnecessary expense.

The change in rule 14 was suggested by Mr. Boutet and Mr. Wymer, in order that inspector may be able to properly designate defect upon body of car.

Mr. Harvey moved the change in rule 17 as it would enable the car to be kept in use more constantly.

Mr. Schultz moved the change in rule 21 as it was stated that some companies were billing for temporary running boards on wrecked cars being sent home.

There was considerable difference of opinion with regard to rule 32, and the revised wording was agreed upon by a committee composed of Messrs. Harvey, Schultz and Wymer.

Mr. Schultz moved the elimination of rules 37, 38, 39 and 40 in order to transfer responsibility from the delivering line to the car owner, where it belongs, as these rules are the cause of cars not being repaired away from home.

The motion to make the changes in rule 43 was made by Mr. Schultz, upon the suggestion of Mr. Campbell.

Mr. Boutet suggested striking out the word "repair" in rule 49 as being unnecessary.

A motion was made by Mr. Schultz that in rule 58 the time is too short to put the hose out of service.

Mr. Schultz made the suggestion with regard to the change in rule 68 on account of the fact that when mated wheel, slid 2 in. or over, it must be scrapped.

The suggestions with regard to rule 93 were made by Mr. Harvey and Mr. Schultz, as it was thought that the least possible time to permit the bill to be made up should only be allowed.

Mr. Boutet moved that the attention of the committee on prices be called to rule 104, regarding the credit allowances on non M C B standard brake beams. This is necessary on account of the different prices of beams.

The change in rule 115 was suggested by Mr. Schultz, his explanation being that under the present rule the railroad company can compel the movement of the trucks with freight charges prepaid, 2,000 miles and over on their own line. This practically prohibits the shipping home of trucks for long distances. Mr. Campbell moved the elimination of the word "axles" stating that the roads now have more 50,000 pounds capacity axles than they need.

A revised wording for rule 120 was moved by Mr. Schultz. He stated that transportation and mechanical officials practically agree that the idea of moving a wornout car many miles in a revenue train, has outlived its day. It was felt that there is need for some definite action with regard to handling such cars and the correction suggested is to eliminate the home route card. Mr. Boutet suggested that a representative of the chief interchange bureau or the head of the car department of a disinterested line examine the car, and that the car be repaired just where it is. Mr. Boutet also suggested that in a case of private ownership with an unserviceable car, authority must be given by the line to put the car in safe condition.

Mr. Schultz proposed the change in rule 121 stating that this is a case of penalizing the party who is not a party to the scheme and in no way responsible for it.

Comparative Tests of Jacobs-Shupert and Radial-Stay Boilers

(Continued from February Issue.)

Program and Description of Tests.

For the purpose of determining the performance of the Jacobs-Shupert boiler as compared with that of a radial-stay boiler, an elaborate series of tests was outlined. The outline embraced the following provisions:

The boilers to be tested were to be designed for locomotive service and to be identical in their general dimensions. They were to differ from each other only in the construction of the firebox and in the means employed for supporting it. One boiler was to be equipped with a Jacobs-Shupert firebox and the other with a radial-stay firebox conforming to the best present-day practice.

A laboratory was to be provided in which the two boilers could be erected and equipped with all apparatus necessary for testing. The tests specified were to be grouped into three series designated as Series A, B, and C, respectively.

Series A was planned to disclose the relative amount of heat absorbed by the fireboxes and by the tubes of the two boilers under similar condition of operation. To facilitate these tests, it was proposed to have the boilers constructed with a partition separating the water space into two compartments, one of which was to include the firebox surface and the other the tube surface. In carrying out the tests, these compartments were to be separately fed with weighed water. Not less than three tests, one at low power, one at medium power, and one at high power, were to be made upon each boiler. It was believed that the results would serve to establish the relative value of a unit area of firebox heating-surface as compared with that of a unit area of tube heating-surface, facts which American engineers have long desired to know, and that they would disclose the difference, if any, in the heat-absorbing capacity of the two fireboxes tested.

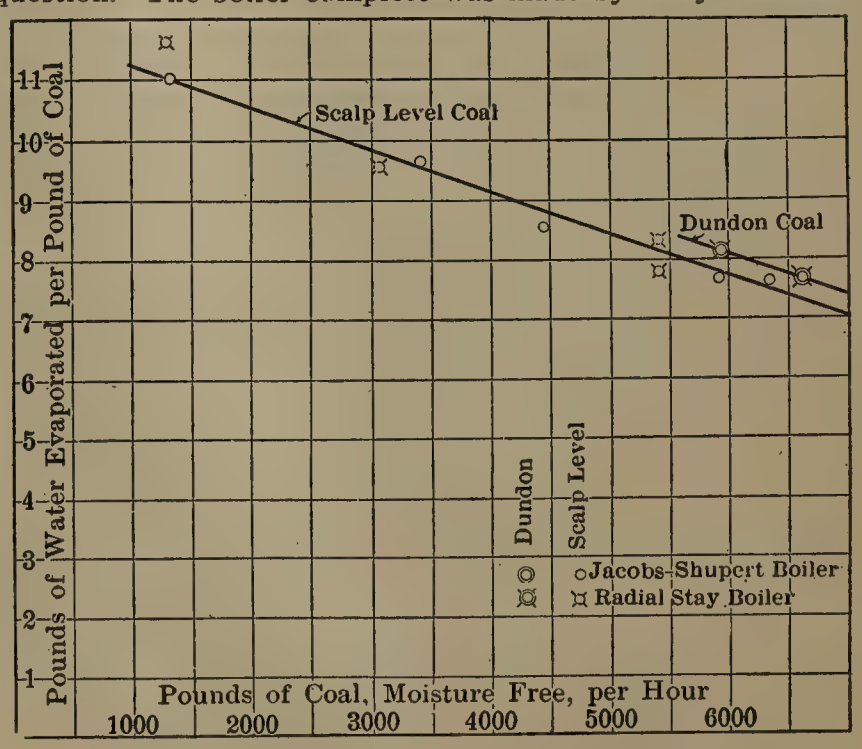
Series B was to be made up of tests of normal boilers. The boilers which had served in the tests of Series A were to undergo such reconstruction as might be found necessary to removal of the partitions. This accomplished, there would be available for the further work a normal Jacobs-Shupert boiler and a normal radial-stay boiler. Each boiler was then to be subjected to a series of evaporative tests for the purpose of establishing its evaporative efficiency and capacity under different rates of power. In addition to data usually secured in boiler testing, it was proposed to make of record such information as might be possible concerning the circulation of water within the two boilers. The purpose of this series was to secure an accurate measure of the evaporative performance of the Jacobs-Shupert boiler and of a normal radial-stay boiler.

Series C was planned to disclose the relative strength of the two boilers under low-water conditions. In preparation for the tests of this series the boilers were to be removed from the testing laboratory and set up with everything necessary to their operation in a location where their explosion would result in no harm to surrounding property. Adequate provisions were to be made for the safety of observers. The boilers were to be operated, the supply of feedwater was to be cut off or so controlled that the firebox would be uncovered, and the low-water conditions were to be continued until failure occurred.

The tests contemplated by this outline have now been entirely carried out. It is the purpose to present in detail a description of the boilers and of the apparatus and methods employed in testing them.

Design of the Boilers.

The boilers tested are shown in their general dimensions by Fig 1. The firebox-end of the Jacobs-Shupert boiler was taken at random from a lot which were under construction for a railroad company. No effort was made to have the particular one chosen stronger or better than the others which were going through the shop. In its dimensions and in the specifications which controlled in its construction, it conformed to the requirements of the railroad company in question. The boiler complete was made by the Jacobs-Shu-



-Water evaporated per pound of coal. Tests Series B. Without arch.

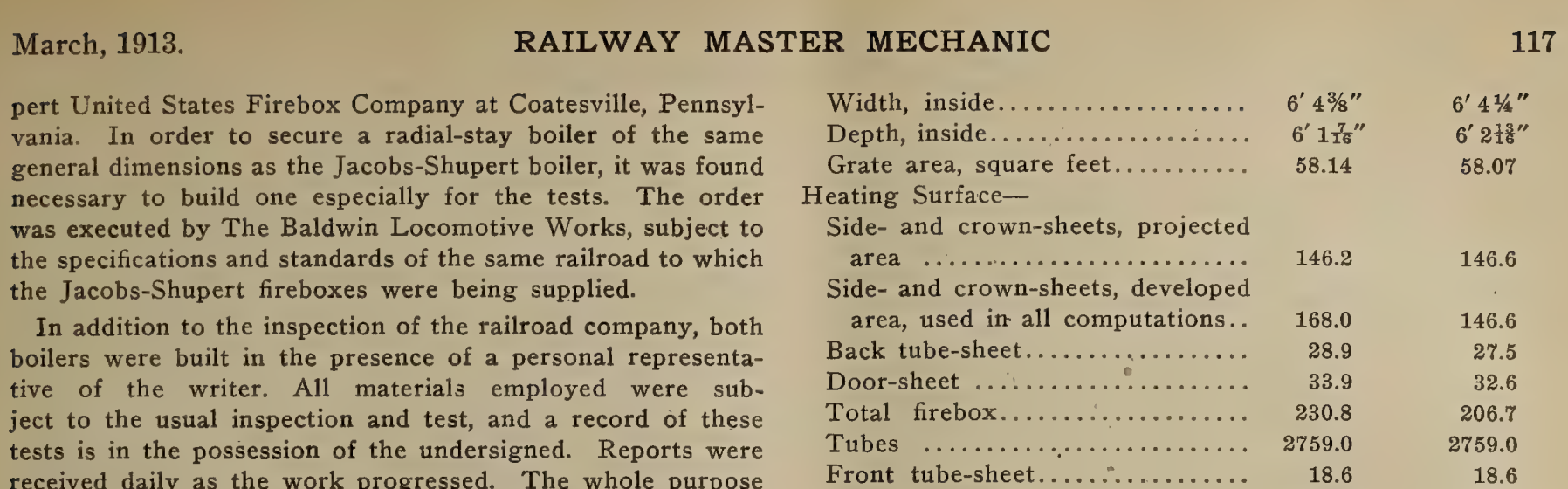
Fig. 7.

pert United States Firebox Company at Coatesville, Pennsylvania. In order to secure a radial-stay boiler of the same general dimensions as the Jacobs-Shupert boiler, it was found necessary to build one especially for the tests. The order was executed by The Baldwin Locomotive Works, subject to the specifications and standards of the same railroad to which the Jacobs-Shupert fireboxes were being supplied.

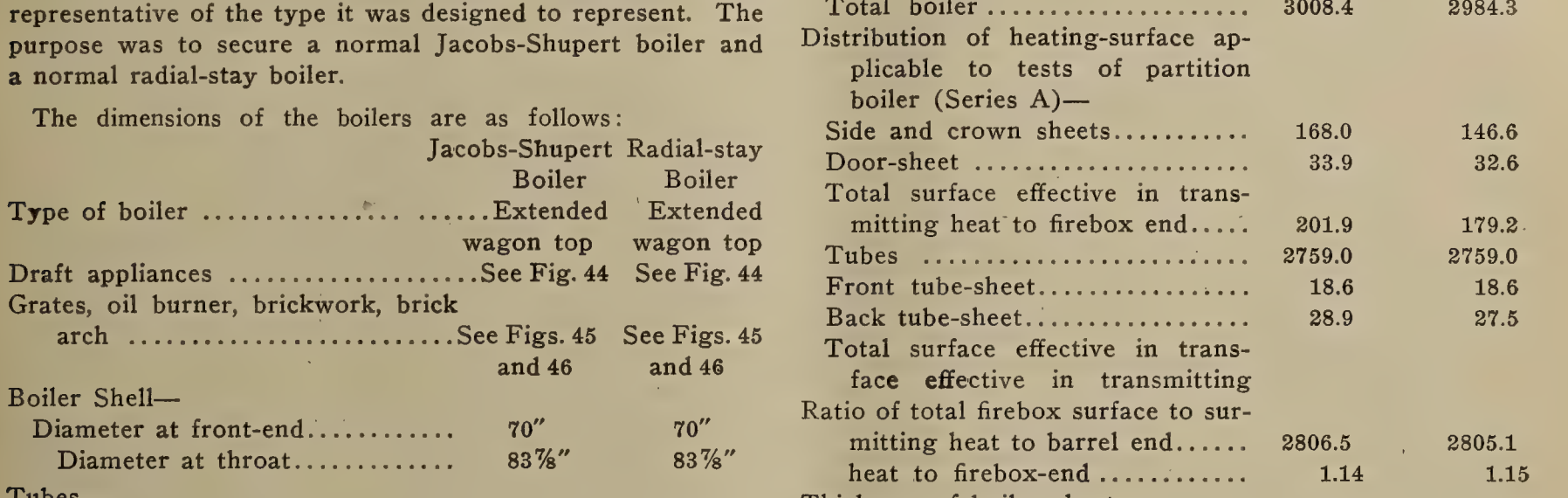
In addition to the inspection of the railroad company, both boilers were built in the presence of a personal representative of the writer. All materials employed were subject to the usual inspection and test, and a record of these tests is in the possession of the undersigned. Reports were received daily as the work progressed. The whole purpose was to secure two boilers, each of which should be entirely representative of the type it was designed to represent. The purpose was to secure a normal Jacobs-Shupert boiler and a normal radial-stay boiler.

The dimensions of the boilers are as follows:

	Jacobs-Shupert Boiler	Radial-stay Boiler
Type of boiler	Extended wagon top	Extended wagon top
Draft appliances	See Fig. 44	See Fig. 44
Grates, oil burner, brickwork, brick arch	See Figs. 45 and 46	See Figs. 45 and 46
Boiler Shell—		
Diameter at front-end	70"	70"
Diameter at throat	83⅞"	83⅞"
Tubes—		
Number	290	290
Length	18′ 2"	18′ 2"
Diameter	2¼"	2¼"
Firebox—		
Length, inside	9′ 1⅝"	9′ 1 11/16"
Width, inside	6′ 4⅜"	6′ 4¼"
Depth, inside	6′ 1 7/16"	6′ 2 13/16"
Grate area, square feet	58.14	58.07
Heating Surface—		
Side- and crown-sheets, projected area	146.2	146.6
Side- and crown-sheets, developed area, used in all computations	168.0	146.6
Back tube-sheet	28.9	27.5
Door-sheet	33.9	32.6
Total firebox	230.8	206.7
Tubes	2759.0	2759.0
Front tube-sheet	18.6	18.6
Total barrel	2777.6	2777.6
Total boiler	3008.4	2984.3
Distribution of heating-surface applicable to tests of partition boiler (Series A)—		
Side and crown sheets	168.0	146.6
Door-sheet	33.9	32.6
Total surface effective in transmitting heat to firebox end	201.9	179.2
Tubes	2759.0	2759.0
Front tube-sheet	18.6	18.6
Back tube-sheet	28.9	27.5
Total surface effective in transface effective in transmitting		
Ratio of total firebox surface to surmitting heat to barrel end	2806.5	2805.1
heat to firebox-end	1.14	1.15
Thickness of boiler sheets—		
Smoke-box	½"	½"
Shell, joint ring	23/32"	23/32"
Shell, front section	¾"	¾"
Shell, middle section	13/16"	13/16"
Shell, back section	⅞"	⅞"



—General drawing of Jacobs-Shupert boiler.



—General drawing of radial-stay boiler.

Figure 1.

Shell, throat-sheet	7/8"	7/8"
Shell, front flue-sheet	1/2"	1/2"
Firebox, crown-sheet	3/8"	3/8"
Firebox, side-sheets	3/8"	3/8"
Firebox, back sheet, inside	3/8"	3/8"
Firebox, back sheet, outside	9/16"	9/16"
Firebox, outside wrapper sheet	1/2"	1/2"
Firebox, section, stay-sheets	3/8"	
Firebox, back flue-sheet	9/16"	9/16"
Firebox sections—		
Number	11	
Width	10"	
Boiler stays—		
Crown-bars, number		2
Crown stays, diameter		1 1/8"
Button head, stays, rows		10
Crown bolts, diameter		1 1/8"
Stay-bolts, diameter		1"
Rivets, size—		
Boiler shell	1 1/4"	1 1/4"
Firebox, inside	3/4"	3/4"
Firebox, outside	1"	1"
Mud-ring	1"	1"

In Series A each boiler was divided into two distinct compartments by the introduction of a partition between the firebox and barrel. The partition was simply a back tube-sheet extended as a single flat plate to the wrapper-sheet and mud-ring, and riveted in place between the fire-box and barrel. In series B the regular flue-sheet was employed, which necessitated the removal of the partitions. This was readily accomplished in the Jacobs-Shupert boiler by cutting openings through the partition with oxyacetylene flame, thus transforming the partition into a flue-sheet normal in form for this type of boiler.

The removal of the partition in the radial-stay boiler was a more difficult matter. In this boiler the back tube-sheet was connected with the side-sheet and crown of the furnace through the introduction of an angle-iron, and it extended to the outside shell of the boiler and was secured thereto between the angle on one side and the throat-sheet on the other side. To make a satisfactory job it was found necessary to remove the whole sheet. The rivets between the firebox and the angle were cut, and the acelylene torch was used to cut out the sheet just inside of the shell.

In retubing the boilers after the reconstruction of their fireboxes, all tubes were welded into the firebox tube-sheet. This was done in anticipation of the low-water tests (Series C) which were to conclude the experimental work. This precaution was taken because low-water sometimes allows the tube-sheet to be forced off the tubes with the result that the failure is a tube-sheet failure. It was the particular purpose of the low-water tests, which were anticipated, to subject the crown of the firebox to conditions so severe as to bring about its failure, and it was thought best to take every precaution to prevent this process being interfered with by a premature failure of the tube-sheet. The advantage which might accrue if the practice of welding the tubes were more general is to be seen in the fact that throughout the tests of Series B which followed the refitting, the tubes were always tight.

Arrangement of the Laboratory.

The boilers having been completed, they were installed in a temporary building erected to receive them on the grounds of the Lukens Iron & Steel Company. They were erected side by side and each was equipped for testing independent of the other. The general arrangement of the boilers and their accessory apparatus as installed when oil was used as fuel is shown by Fig. 2.

The boilers were erected on concrete piers. The pier at the firebox end was given a flat surface and was a foot larger all around than the mud-ring. Four cast-iron pedestals served to support the mud-ring of the boiler 12 inches above the surface of this pier. When oil was used as fuel, the necessary brickwork was built up from the pier, and when coal was used as fuel, the space between the mud-ring and the pier was filled with steel sheets to serve the purpose of an ash-pan. Dampers in these sheets supplied means for controlling the draft.

To permit the boilers to be operated under conditions common in service, they were equipped with the normal front-end arrangement and stack, except that the usual netting was entirely omitted. A normal exhaust pipe and tip was fixed to the bottom of the smoke-box, and suitable outside piping was provided to convey the steam generated by

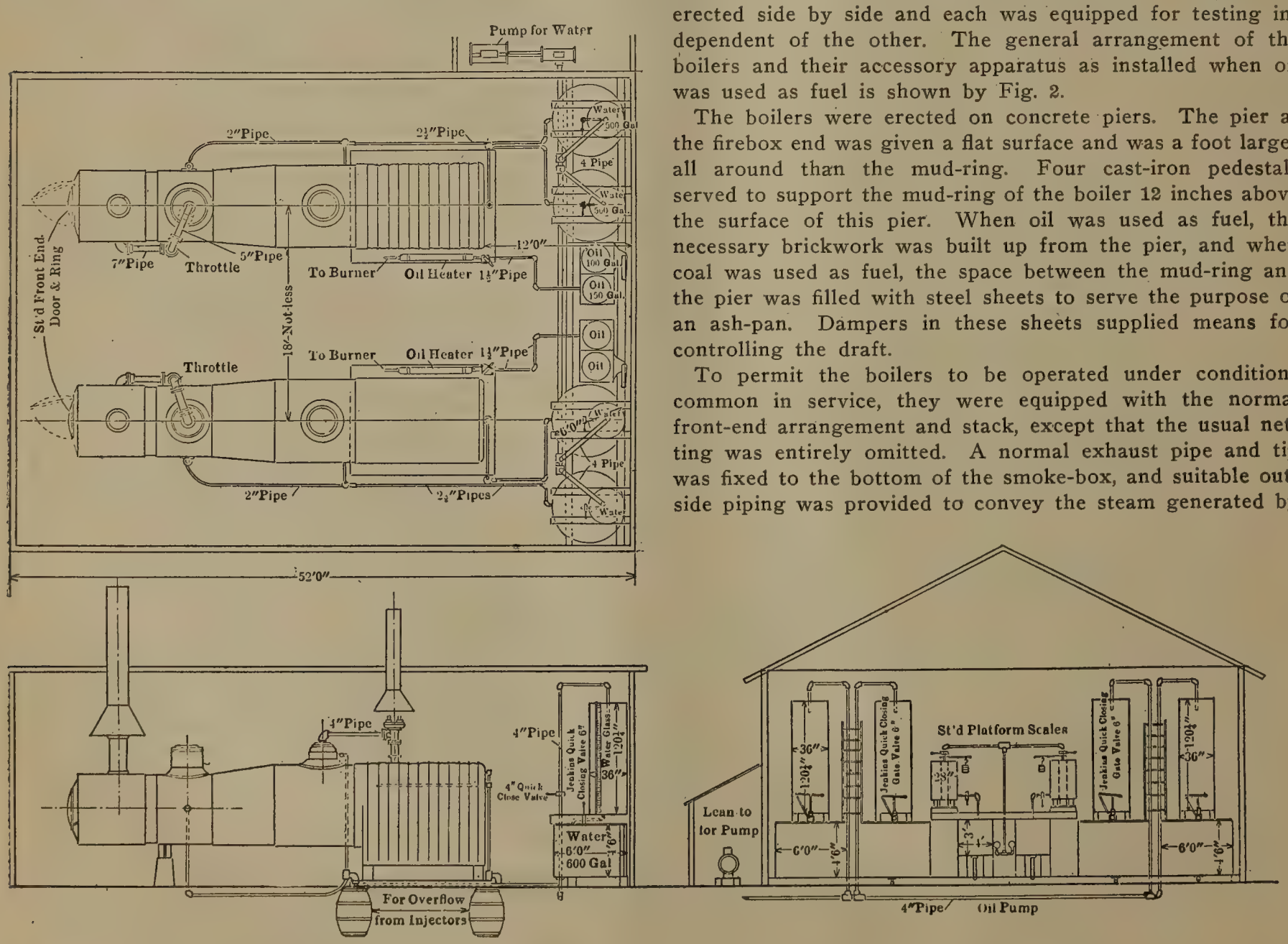


Fig. 2—Plan, Elevation and Section of Testing Laboratory. Boilers Arranged for Oil Fired Tests.

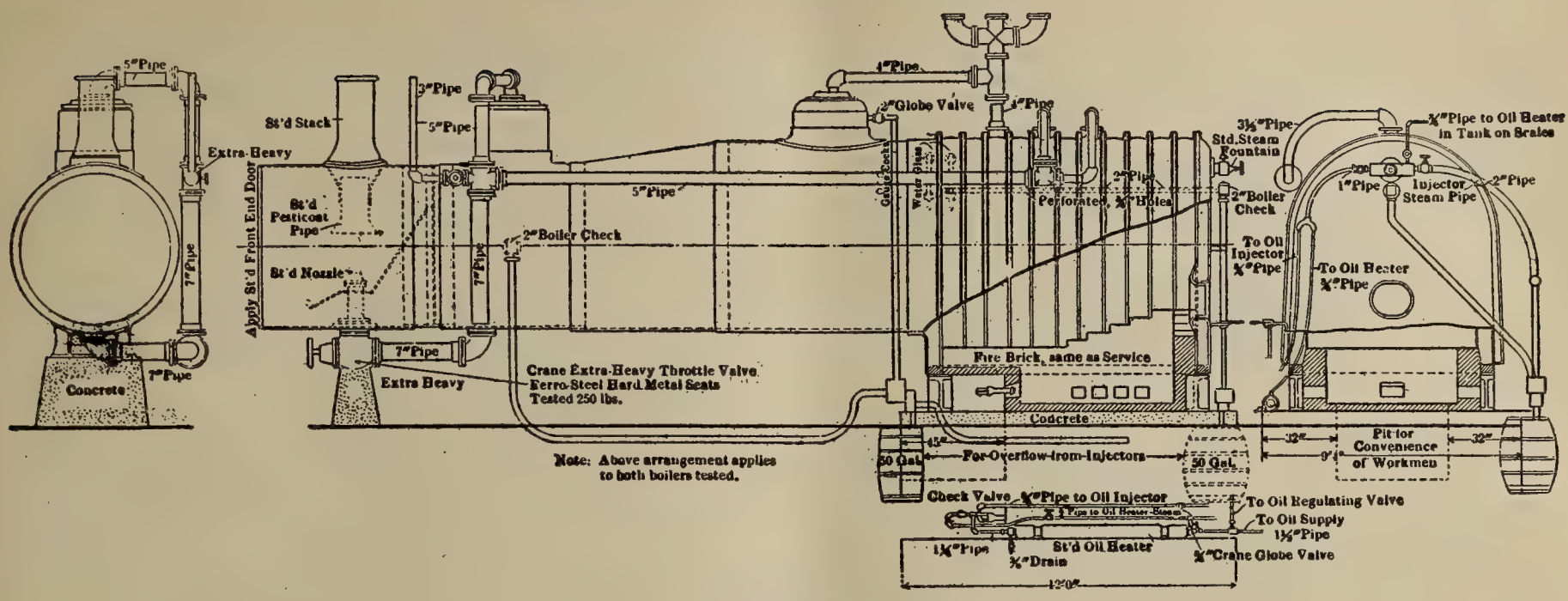


Fig. 3—General Elevation of Jacobs-Shupert Boiler Showing Piping and Other Arrangements for Test.

the boiler to the lower end of the exhaust pipe. This arrangement provided for a delivery of most of the steam generated through the exhaust tip, and the steam thus discharged gave rise to the usual draft action. The control of the draft was provided for by the valve in a 7-inch pipe which served, in the course of the tests, the purpose of the usual locomotive throttle. As the steam passing it was reduced from the pressure of the boiler to that of the exhaust pipe, it constituted an excellent point of observation from which to secure data concerning the quality of the steam discharged. The addition of a gage and a thermometer made the whole arrangement serviceable as a calorimeter. Steam in excess of that required to produce the necessary draft conditions was discharged from a 3-inch blow-off pipe or was discharged by the safety-valves. The boilers and connected steam-piping were well covered with asbestos covering. In all of these respects the equipment of the two boilers was identical.

The laboratory as described by the preceding paragraphs served for all the tests of Series A and B. In its operation, a staff of eight men were employed, acting under the immediate supervision of Mr. J. F. Butler.

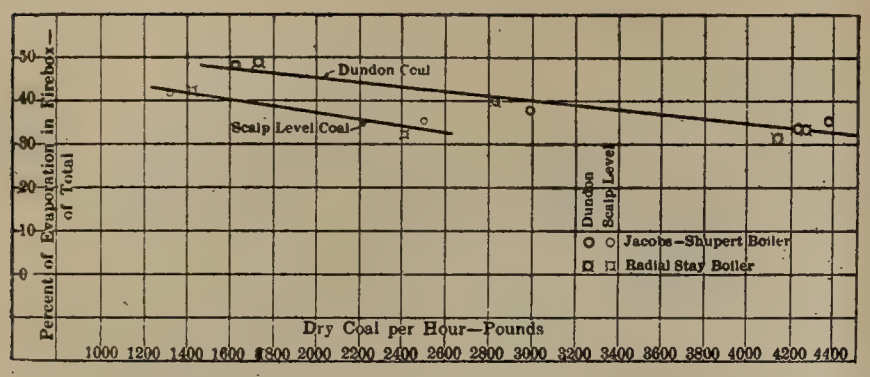
While the tests of Series A and B were in progress, an investigation was conducted by Mr. George L. Fowler, concerning the movement of water within the boilers, the results of which are given in the chapter entitled "Some Facts with Reference to the Circulation of Water in Locomotive Boilers." At the conclusion of the tests of Series A and B, the boilers were dismantled, the covering upon them was removed, and they were transferred to the ground selected as a site for the low-water tests (Series C).

Relative Value of Firebox Heating Surface and of Tube Heating Surface.

Many years have passed since any effort has been made to establish by experimental processes the relative amount of heat absorbed by the firebox and by the tubes of a locomotive boiler. In the meantime, boilers have greatly increased in size and they have been so changed in their proportion that no measure of a quarter of a century ago can now be accepted as applying to present-day practice. With the hope of making a contribution which would be of interest to the engineering profession, it was early arranged that the tests to be undertaken by the Jacobs-Shupert United States Firebox Company should include such a determination. In carrying out this purpose, both the Jacobs-Shupert boiler and the radial-stay boiler as initially constructed were partitioned off by an extension of the tube-sheet to the outside shell of the boiler. This partition separated the interior of the boiler into two compartments. The compartments were connected only through the medium of the steam piping, the arrangement of which was similar to that of two boilers connected to a common steam header. In the process of testing, both compartments received heat from a single source; namely, the interior of the firebox, but each compartment was fed from a separate supply of weighed water, and its output of steam was dealt with as though it had been a separate boiler.

The location of the partition was such that the heat transmitted by the tube-sheet of the firebox was delivered to the barrel-end of the boilers, and the evaporation from this portion of the firebox was weighed in with that of the tubes. The observed data give the actual weighings of water fed to each portion of the boiler, and all items involving water evaporated, which follow in the tables, are deduced from these values, being based upon the observed results referred to the actual surface which was effective in bringing about the result. The deduced values covering the firebox performance have been obtained by multiplying the evaporation actually obtained by the ratio of the total firebox surface to the firebox surface effective in producing vaporization in the firebox-end of this boiler. The small increment, which by this correction is added to the observed evaporation of the firebox, is in the deduced results, subtracted from the observed evaporation of the barrel. The effect of this correction is merely to credit to the firebox and debit to the barrel the heat transmitted by the back tube-sheet. These statements are, of course, applicable to both boilers.

In the operation of the boilers constructed and equipped as described, a series of conditions appeared which, while unexpected, were interesting. It was found after starting fires under cold boilers that the firebox-end of the boiler would begin to make steam while the barrel remained comparatively cold. The steam thus generated by the firebox passed through the piping to the cooler steam space of the barrel, where much of it condensed. As a result, the water-level of the barrel would gradually rise and the water-level in the firebox-end would fall. The progress of these changes soon made it necessary to blow off water from the barrel, and to feed water to the firebox-end. This action operated greatly to prolong the process of getting the boiler into action. After the barrel began to make steam, both compartments performed normally as two boilers of a single battery, the quality of steam delivered from each being practically of the same value. It is obvious that the action described had nothing to do with the differences in the design of the two boilers, but was the result of the manner in which they were fitted up for the test in hand. The action occurred in connection with both boilers. It was completely


Percent of Evaporation in Firebox — of Total
Dundon Coal
Scalp Level Coal
Dundon Scalp Level
Jacobs-Shupert Boiler
Radial Stay Boiler
Dry Coal per Hour—Pounds
1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000 3200 3400 3600 3800 4000 4200 4400

Ratio of evaporation in firebox to coal burned per hour. Tests Series A—Coal Fuel.

Figure 5.

overcome by adding a 2-inch emergency pipe connecting a washout hole in the bottom of the barrel with a washout hole in the water-leg of the firebox. This connection permitted, during the process of warming up, the firebox-end to be supplied with water from the barrel-end, and it established a channel for circulation which was found to be necessary to normal action. The pipe in question was provided with two valves and a drain between so that the circulation could be effectually stopped after both parts of the boiler were gotten into action.

The tests upon the partitioned boilers are referred to throughout this report as those of Series A. Nine tests were made with oil as fuel, five upon the Jacobs-Shupert boiler and four upon the radial-stay boiler. These were followed by twelve tests, during which coal was used as fuel, six upon the Jacobs-Shupert boiler and six upon the radial-stay boiler. A summarized statement of the more significant facts developed is as follows:

Series A. Oil Fuel.

Numerical values which are of especial interest are presented in Table 1, and a diagram showing the percentage of the total heat absorbed by the firebox as Fig. 4. The points plotted in this diagram include all results as obtained from both the Jacobs-Shupert boiler and the radial-stay boiler. Referring to Table 1, it will be seen that each pound of oil burned resulted in the evaporation of from 15.9 to 13.2 pounds of water, the amount diminishing as the rate of power is increased. The thermal efficiency of the Jacobs-Shupert boiler under low rates of power may exceed 80 per cent. and even under high rates of power it is above 70 per cent. It can be shown that when the Jacobs-Shupert boiler is made to evaporate 20,000 pounds of water an hour, it wlil generate 14.14 pounds of steam for each pound of oil burned. It can be shown also from data to be presented later in this chapter that at the same rate of power it will generate 8.3 pounds of steam for each pound of Dundon coal burned, so that a comparison of the results here presented, with others which are to follow, makes one pound of oil in locomotive service equal to 1.7 pounds of high-grade bituminous coal.

With reference to the distribution of work between the firebox and the tubes, Fig. 4 shows that the fraction of the total heat transmitted which is taken up by the firebox is greatest when the rate of power is low. Thus, when only 800 pounds of oil are being fired per hour, 54 per cent of the total evaporation is from the firebox surface, whereas when 2,200 pounds of oil are fired per hour, 40 per cent of the total transmission is through the firebox. This statement shows that the proportion of the whole work done by the firebox is not only surprisingly large at its maximum, but that it continues to be large under all conditions of operation. Translating the facts presented by these values given into measures which are more readily recognized, and expressing them in round numbers, it may be said that when served with 2,200 pounds of oil per hour:

The Jacobs-Shupert boiler will evaporate 40,000 pounds of water per hour. Of this amount, 16,000 pounds will be evaporated by the firebox and 24,000 pounds by the barrel.

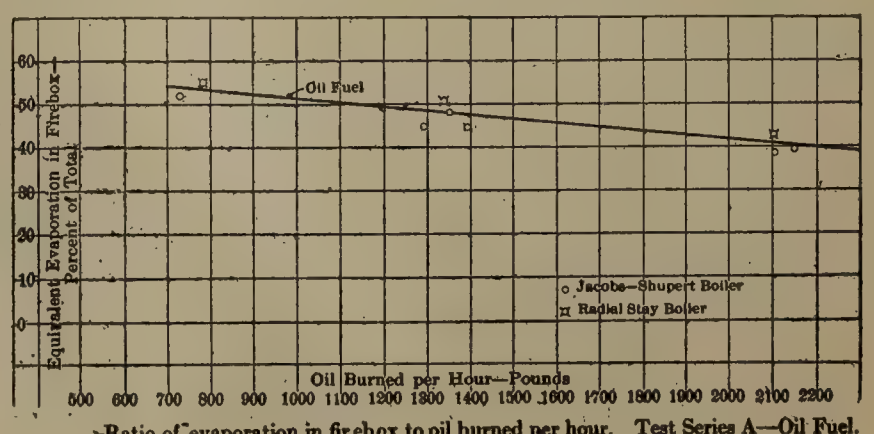
The whole boiler will develop 1,200 horsepower, of which amount nearly 500 horsepower will be developed by the firebox.

The average rate of evaporation per foot of heating-surface per hour for the whole boiler will be 9.78 pounds.

The average rate of evaporation per foot of heating-surface per hour for the firebox will be 49.59 pounds, and for the barrel 6.47 pounds.

The ratio of heat absorbed per foot of heating-surface by the firebox to that absorbed per foot of tube heating-surface is as 7.6 to 1.

While the tests show the efficiency of the boilers when fired with oil to be high, and while the results are very consistent, they cannot be accepted as constituting a basis of comparison which admits of a high degree of refinement. This fact arises from difficulties encountered in the maintenance of a satisfactory fire. The burning of oil in large quantities within the firebox of a locomotive boiler presents a problem which has not yet been perfectly solved. In the case of the boilers experimented upon, the burner, the brickwork, and all other provisions affecting combustion were made to agree with the practice of large railway corporations having hundreds of locomotives oil-fired. It is believed that the results obtained at the testing plant were probably as satisfactory as any which are obtained upon the road, but it was impossible in the maintenance of the fire to prevent deposits of sooth upon the heating-surface. The practice of thoroughly cleaning the heating-surfaces before starting fires, and of afterwards doing nothing to them during the progress of the test, resulted in abnormally high smoke-box temperatures and in the accumulation of considerable quantities of soot which was required to be removed at the end of the test. All results obtained under this practice were finally discarded. Later recourse was had to sanding the tubes, a practice common on railroads. At regular intervals during the progress of the test a scoopful of sharp sand was carefully distributed through the door into various portions of the furnace in such a manner that the particles would be taken up by the draft and carried through the tubes, cleaning them as by a sand-blast process. While this practice gave cleaner tubes, it did not clean the firebox, and an attempt was made to reach this portion of the heating-surface by using an air-blast with sand. As a result of these efforts systematically applied, the results obtained are fairly consistent, but since it is known that the performance of the boiler was more or less affected by the presence of soot, and since it can never be certain that the extent of this defect was constant for all the tests made of record, the results cannot be accepted as constituting a measure of the relative performance of the two fireboxes, which is satisfactory from a scientific point of view. For this reason, also, no attempt has been made to elaborate, through a complete heat balance, the computations of the oil-fired tests.


Equivalent Evaporation in Firebox — Percent of Total
Oil Fuel
Jacobs-Shupert Boiler
Radial Stay Boiler
Oil Burned per Hour—Pounds
500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200

Ratio of evaporation in firebox to oil burned per hour. Test Series A—Oil Fuel.

Figure 4.

SERIES A—OIL FUEL

Table 1

DESIGNATION OF TEST	DRAFT IN FRONT OF DIAPHRAGM INCHES OF WATER	OIL PER HOUR pounds	EQUIVALENT EVAPORATION PER HOUR			EQUIVALENT EVAPORATION PER SQUARE FOOT OF HEATING SURFACE PER HOUR			PER CENT. OF TOTAL EVAPORATION IN FIREBOX	EQUIVALENT EVAPORATION PER POUND OF FUEL pounds	EFFICIENCY [OVER ALL] PER CENT. OF B. T. U. ABSORBED BY THE BOILER PER LB. OF FUEL FIRED
			FIREBOX pounds	BARREL pounds	TOTAL pounds	FIREBOX pounds	BARREL pounds	TOTAL pounds			
1	13	15	52	53	54	56	57	58	55	63	69
A-1-J	1.5	736	6,136	5,604	11,740	26.59	2.02	3.90	52.27	15.96	80.48
A-2-J	2.6	1,453	10,428	11,509	21,937	45.18	4.14	7.29	47.54	15.10	76.35
A-3-J	3.0	1,399	9,227	11,650	20,877	39.98	4.19	6.94	44.27	14 92	75.44
A-4-J	5.2	2,156	11,683	18,186	29,869	50.62	6.55	9.93	39.11	13.86	70.05
A-5-J	6.5	2,117	11,206	17,750	28,956	48.55	6.39	9.63	38.70	13.68	69.15
A-6-R	1.2	790	6,914	5,546	12,460	33.45	2.00	4.18	55.48	15.77	79.72
A-7-R	2.8	1,504	9,743	12,141	21,884	47.14	4.37	7.33	44.52	14.55	73.55
A-8-R	2.6	1,440	10,946	10,734	21,680	52.96	3.86	7.27	50.49	15.06	76.14
A-9-R	6.1	2,106	11,942	15,847	27,789	57.78	5.71	9.31	42.97	13.20	66.70

Tests of Series A with Coal.

The more essential facts developed by these tests are set forth in Table 2. This table includes the results of twelve tests, six upon the Jacobs-Shupert boiler and six upon the radial-stay boiler. For each boiler, two tests were made with Scalp Level coal and four with Dundon coal. The Scalp Level coal burns with a short flame. Its analysis (coal as fired) is as follows:

	Per cent.
Fixed carbon	75.90
Volatile matter	16.45
Moisture	3.38
Ash	3.50

The Dundon coal is a long-flame gas coal. Its analysis (coal as fired) is as follows:

	Per cent.
Fixed carbon	49.54
Volatile matter	34.34
Moisture	.38
Ash	12.74

The results show that under low rates of power either boiler will give an evaporation of more than 10 pounds of water per pound of coal. For the whole series of tests the evaporation is normally above 8 pounds of water per pound of coal. A comparison of the performance of the whole boiler when delivering a definite amount of power, shows that the thermal efficiency is from 8 to 10 per cent less when coal is fired than when oil is used as fuel.

The percentage of the total heat absorbed by the boiler, which is taken up by the firebox when the fuel is coal, is shown diagrammatically by Fig. 5. The points plotted upon this diagram fall into two series of groups. The first located by double circles represents all results obtained with Dundon coal, both from the Jacobs-Shupert boiler and the radial-stay boiler. The second located by single circles represents results obtained with the Scalp-Level coal. Neither boiler was equipped with the brick arch during these tests. It is interesting to note that the short-flame coal is at a distinct disadvantage as compared with the long-flame in giving up heat to the firebox. When Dundon coal is used as fuel, the percentage of the total heat absorbed by the firebox varies from a little less than 50 to a little more than 30, depending upon the rate of power, the percentage diminishing as the power is increased. When Scalp-Level coal is used, the percentage is about 8 less than when Dundon coal is used.

If we assume the Jacobs-Shupert boiler to be evaporating 20,000 pounds of water per hour, the percentage of the total heat absorbed by the boiler which is taken up by the firebox, is as follows:

	Per cent.
When oil is used as fuel	42
When long-flame bituminous coal is used as fuel	42
When short-flame is used as fuel	35

TESTS SERIES A—COAL FUEL

Table 2

DESIGNATION OF TEST	DRAFT IN FRONT OF DIAPHRAGM INCHES OF WATER	KIND OF COAL	MOISTURE FREE COAL FIRED PER HOUR pounds	EQUIVALENT EVAPORATION PER HOUR			EQUIVALENT EVAPORATION PER SQUARE FOOT OF HEATING SURFACE PER HOUR			PER CENT. OF TOTAL EVAPORATION IN FIREBOX	EQUIVALENT EVAPORATION PER LB. OF MOISTURE FREE COAL AS FIRED pounds	EFFICIENCY [OVER ALL] PER CENT. OF B. T. U. ABSORBED BY THE BOILER PER LB. OF FUEL FIRED
				FIREBOX pounds	BARREL pounds	TOTAL pounds	FIREBOX pounds	BARREL pounds	TOTAL pounds			
1	18	16	21	52	53	54	56	57	58	55	64	69
A-101-J	1.2	Scalp Level	1,324	6,149	8,363	14,514	26.64	3.01	4.82	42.36	10.96	71.62
A-102-J	1.3	Dundon	1,622	6,944	7,306	14,250	30.09	2.63	4.74	48.74	8.79	62.01
A-103-J	4.4	Scalp Level	2,498	8,949	16,379	25,328	38.77	5.90	8.42	35.33	10.14	65.79
A-104-J	4.2	Dundon	2,990	9,826	15,853	25,679	42.57	5.71	8.54	38.27	8.59	67.39
A-105-J	7.3	Dundon	4,228	11,982	23,423	35,405	51.92	8.43	11.77	33.84	8.38	58.65
A-106-J	6.7	Dundon	4,392	12,043	22,340	34,383	52.18	8.04	11.43	35.03	7.83	55.12
A-107-R	1.5	Dundon	1,721	7,225	7,538	14,769	34.95	2.71	4.95	48.93	8.58	60.22
A-108-R	1.1	Scalp Level	1,434	6,383	8,620	15,003	30.88	3.10	5.03	42.54	10.46	68.65
A-109-R	3.4	Scalp Level	2,418	7,734	16,427	24,161	37.42	5.91	8.10	32.01	9.99	64.68
A-110-R	3.1	Dundon	2,835	9,848	14,589	24,437	47.64	5.25	8.19	40.30	8.62	60.51
A-111-R	7.7	Dundon	4,250	11,992	23,782	35,774	58.02	8.56	11.99	33.52	8.42	61.10
A-112-R	6.4	Dundon	4,138	11,009	23,544	34,553	53.26	8.48	11.58	31.86	8.35	60.09

This suggests the possibility of the existence of some relation between the percentage of total heat which is absorbed by the firebox and the character of the coal. For example, it may be that the substitution of anthracite for bituminous coal would operate to reduce the total work done by the firebox below 35 per cent. The explanation is perhaps due to a changed condition in the tubes rather than in the firebox. It may be that the freer burning coal deposits less soot in the tubes and permits them to absorb a larger proportion of the total heat delivered.

It will be of interest to note that with Dundon coal when the rate of combustion equals 4,341 pounds per hour, which is near the highest reached in firing the partitioned boilers:

The Jacobs-Shupert boiler will evaporate 35,405 pounds of water per hour, of which amount 11,982 pounds will be evaporated from the firebox and 23,423 pounds from the tubes.

The whole boiler will develop 1,026 horsepower, of which amount 304 horsepower will be developed by the firebox.

The average rate of evaporation per foot of heating-surface per hour for the whole boiler will be 11.77 pounds.

The average rate of evaporation per foot of heating-surface per hour for the firebox will be 51.92 pounds, and for the barrel 8.43 pounds.

The rate of heat absorbed per foot of heating-surface by the firebox to that absorbed per foot of tube heating-surface is as 6.15 to 1.

Comparison of the Performance of the Two Fireboxes.

The Jacobs-Shupert firebox and the radial-stay firebox were designed and constructed to have the same over-all dimensions. The heating-surface of both fireboxes, as measured by their projected areas, is substantially the same and is equal to 206.7 feet. But the curved form of the sections of the Jacobs-Shupert firebox gives a developed area which is greater than that of the plain surface of the radial-stay firebox. The developed area of the surface of the Jacobs-Shupert firebox is 230.8 feet, an increase over the surface of the radial-stay firebox of 11 per cent. This increase in the heating-surface of the Jacobs-Shupert firebox is an incident in the development of its design. The purpose of giving the sections of the firebox the shape they have is not primarily that greater heating-surface may be secured, but that a satisfactory structure may result. Nevertheless, a question as to the effect of this increase in heating-surface upon the amount of heat absorbed by the firebox, is one of some importance, and its determination constitutes one of the questions for which the present series of tests was instituted. The results upon this point as briefly reviewed in the short tables presented herewith as Tables 1 and 2, are not conclusive. While results of individual tests may be selected which will show a considerably higher percentage of the total heat absorbed to have been taken up by the Jacobs-Shupert firebox than by the radial-stay firebox, their effect is neutralized by the possibility of other comparisons involving results believed to be equally reliable. The fact as developed by the results of 20 tests seems to indicate that the difference in absorbing capacity of the two fireboxes tested is not sufficient to be established by carefully conducted boiler tests. Heat transmitted by a locomotive firebox is chiefly the result of conduction and convection; radiation probably plays but a small part. Transmission by conduction is a function of differences in temperature. If in the case in hand, a plane in the water space above the crown-sheet is considered as receiving the heat and a parallel plane in the firebox below the crown-sheet as the source of heat supply, the amount of heat transmitted will theoretically be independent of the form of the metallic crown-sheet between. Again, the convection currents have a clear sweep over certain exposed portions of the firebox sections, but do not reach other portions which are between the sections. It is not unlikely that considerations such as these account for the results which have been obtained. These statements apply only to the fireboxes.

Tests Series B—With and Without Arch

CONDENSED TABLE OF RESULTS

Table 3

DESIGNATION OF TEST	KIND OF COAL	MOISTURE FREE COAL PER HOUR pounds	MOISTURE FREE COAL PER SQ.FT. GRATE PER HR. pounds	EQUIVALENT EVAPORATION PER HOUR pounds	EQUIVALENT EVAPORATION PER SQ.FT. HEATING SURFACE PER HR. pounds	BOILER H. P. DEVELOPED	RATIO OF HEATING SURFACE TO H. P. DEVELOPED	EQUIVALENT EVAPORATION PER LB. OF COAL, MOISTURE FREE, FIRED	OVERALL EFFICIENCY	EFFICIENCY EXCLUDING GRATE
1	16	21	22	54	58	59	62	64	69	70
WITHOUT ARCH IN FIREBOX										
B-201-J	Scalp Level	1,389	24.45	15,293	5.08	443	6.8	11.01	71.86	79.75
B-202-J	" "	3,419	60.18	32,861	10.92	953	3.2	9.61	63.37	71.51
B-203-J	" "	4,467	78.63	39,964	13.28	1,158	2.6	8.95	58.29	63.96
B-204-J	" "	5,930	104.38	46,045	15.31	1,335	2.3	7.77	52.23	58.26
B-205-J	" "	6,314	111.14	48,070	15.98	1,393	2.2	7.61	50.41	55 36
B-206-R	" "	1,282	22.04	14,952	5.01	433	6.9	11.68	76.62	79.37
B-207-R	" "	3,051	52.46	29,108	9.75	844	3.5	9.54	62.26	66.41
B-208-R	" "	5,397	92.80	44,658	14.97	1,294	2.3	8.28	54.64	57.67
B-209-R	" "	5,427	93.31	42,404	14.21	1,229	2.4	7.81	52.25	54.39
B-301-J	Dundon	6,631	116.72	50,617	16.83	1,467	2.1	7.63	56.54	57,96
B-302-R	"	5,484	94.29	44,383	14.87	1,287	2.3	8.09	59.23	60.26
WITH ARCH IN FIREBOX										
B-401-J	Scalp Level	1,367	24.06	15,683	5.21	455	6.6	11.47	74.82	78.85
B-402-J	" "	2,656	50.27	30,484	10.13	884	3.4	10.67	69.79	75.50
B-403-J	" "	5,386	94.81	45,701	15.19	1,325	2.3	8.49	56.76	61.12
B-404-J	" "	5,887	103.63	51,759	17.21	1,500	2.0	8.79	57.90	61.27
B-405-R	" "	1,321	22.71	15,452	5.18	448	6.7	11.70	76.50	80.72
B-406-R	" "	2,926	50.31	29,953	10.04	868	3.4	10.24	67.42	72.10
B-407-R	" "	5,069	87.16	44,788	15.01	1,298	2.3	8.84	58.87	62.43
B-501-J	Dundon	6,553	115.35	57,564	19.13	1,669	1.8	8.78	65.34	67.01

Evaporative Tests of a Jacobs-Shupert Boiler and a Normal Radial-Stay Boiler.

At the conclusion of the tests with fireboxes and barrels separated, the boilers were reconstructed to such extent as was necessary to secure the removal of the partitions, which in the previous work separated the firebox-end from the barrel. The reconstruction accomplished, there was available for the further work a normal Jacobs-Shupert boiler and a normal radial-stay boiler. Tests upon the normal boilers were first run using Scalp-Level coal as fuel and without the presence of an arch in the firebox. This series was followed by two tests in which Dundon coal, a long-flame gas coal, was used. After this, the brick arch was added to the firebox and the program of tests practically repeated. The tabulated statement Table 3 presented herewith covers the more important results which were obtained from the entire series. A summary is as follows:

Results of Tests Without the Brick Arch in Firebox.

These are represented in Table 3 by tests 201 to 302, inclusive. The series includes five tests of the Jacobs-Shupert boiler and four tests of the radial-stay boiler when fired with Scalp-Level coal, and one test of each boiler when fired with Dundon coal. The efficiency of a locomotive boiler is highest when the power developed is least. For example, referring to the first test (201), it will be seen that when the Jacobs-Shupert boiler was fired with 1,315 pounds of moisture free coal per hour it—

(a) Evaporated 15,293 pounds of water per hour.

(b Evaporated 5.08 pounds of water per square foot of heating-surface per hour.

(c) Evaporated 11.01 pounds of water per pound of coal.

(d) Developed 443 horse-power.

(e) Developed an overall efficiency of 71.86 per cent.

(f) Developed an efficiency, excluding the grate, of 79.75 per cent.

The precise effect produced by increasing the load upon a boiler is well shown by the values of the heat balance for the several tests run with Scalp-Level coal. For example, tests 201, 202, 204, and 205 represent in the order given an increased rate of power. A statement of conditions and results is as follows:

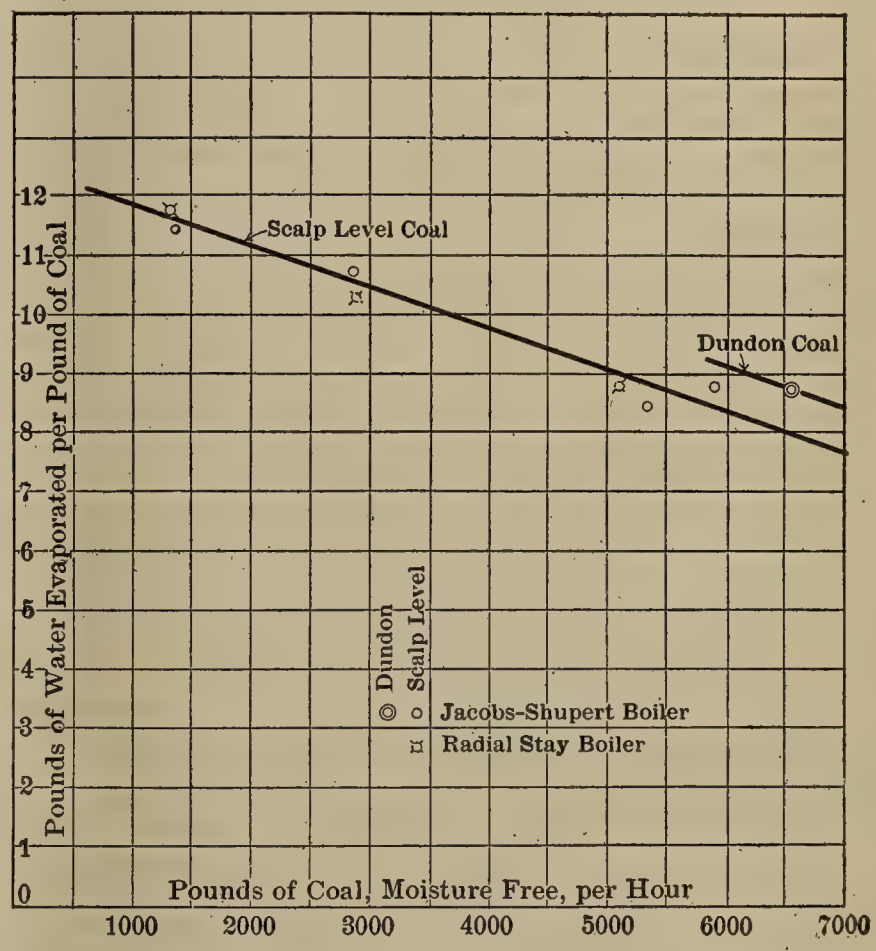
Test number	201	202	204	205
Pounds of coal fired per hour	1,389	3,419	5,930	16,314
Thermal units for each lb. of coal:				
(a) Absorbed by water in boiler	10,687	9,327	7,532	7,388
(b) Lost by moisture in coal	48	34	37	33
(c) Lost by moisture in air	49	53	114	64
(d) Lost by hydrogen in coal	486	497	500	514
(e) Lost by smoke-box gases	1,979	2,731	3,992	4,675
(f) Lost by incomplete combustion	78			
(g) Lost by cinders passing up stack	153	851	1,078	1,012
(h) Lost by combustion in ash	1,187	679	291	185
(i) Lost by radiation and unaccounted for	205	547	881	783
Total B. T. U. per lb. of coal	14,872	14,719	14,425	14,654

By comparing the values in the horizontal lines, the changes resulting from changes in the rate of power may be seen. First, it will be observed that the number of thermal units absorbed by the water in the boiler becomes smaller with each succeeding test. The loss thus sustained is accounted for by the increased amount of heat which goes off with the smoke-box gases and in the form of combustible material which passes out of the stack as cinders.

The evaporative performance of the boilers in terms of pounds of coal fired per hour is shown by Fig. 7. In this figure the double circles represent tests with Dundon coal and the single circles tests with Scalp-Level coal. Tests upon the Jacobs-Shupert boiler are indicated by the plain circles, while the tests on the radial-stay boiler are indicated by combined circles and crosses. The diagram represents all results obtained. Tests 301 and 302 were run with Dundon coal, all others with Scalp-Level coal. The long straight line represents the tests of the Jacobs-Shupert boiler when using Scalp-Level coal, with a maximum error which is less than 3 per cent, and an average error which is less than 1 per cent. It will be seen that the line also represents fairly well the results obtained from the radial-stay boiler, which are marked by crosses. Dundon coal gives a higher evaporation than Scalp-Level coal. A parallel line is drawn through the two points representing the results obtained from the two boilers when fired with Dundon coal.

Results with a Brick Arch in the Firebox.

Upon the completion of tests 201 to 302, inclusive, described in the preceding paragraphs, both boilers were equipped with firebox arches supplied and installed by the American Arch Company. Thus equipped, tests 401 to 501, inclusive, were run.



—Water evaporated per pound of coal. Tests Series B. With arch.

Figure 6.

A summarized statement of the actual values appears in Table 3 and the comparative performance of the two boilers is set forth by Fig. 6. In the latter figure, the long straight line is drawn to represent as nearly as possible the points shown by circles, which are those of the Jacobs-Shupert boiler when fired with Scalp-Level coal. It will be seen that the line also represents fairly well the points located by crosses, which indicate results obtained from the radial-stay boiler. The crosses fall lower than the circles which determine the location of the line. Only one test representing Dundon coal is of record in this group, and this (501) is a test of the Jacobs-Shupert boiler at the highest rate of power developed during the series. In this test, the firing was at the rate of 6,553 pounds of moisture free coal per hour. This rate of firing resulted in:

A rate of combustion equaling 119.38 pounds of coal per foot of grate per hour.

An evaporation of 57,564 pounds of water per hour, or the equivalent of 19.13 pounds of water per foot of heating-surface per hour.

The development of 1,669 boiler horse-power, or the equivalent of one boiler horse-power for each 1.8 foot of heating-surface.

An evaporation per pound of coal, notwithstanding the high rate of power developed, of 8.78 pounds of water.

The maintenance of an overall boiler efficiency of 65.34 per cent, and of the boiler, exclusive of the grate, of 67 per cent.

It is unusual for boilers to be driven to such rates of power. At the Purdue locomotive testing plant, as a result of its first fifteen years of operation, the highest rate of evaporation made of record was 14.45 pounds of water per foot of heating-surface per hour, obtained August 7, 1905, by the use of Youghiogheny coal. At about the same time the report of the Pennsylvania Railroad Company of the St. Louis tests was issued, by which it appeared that the New York Central locomotive No. 3000 had, while on the testing plant, been forced to a rate of 16.34 pounds per foot of heating-surface per hour, which was the maximum for that celebrated series of tests. It is in comparison with these record-breaking performances that the rate of 19.13 pounds obtained for the Jacobs-Shupert boiler at Coatesville is to be considered. So far as the undersigned is informed, it represents the highest rate of power to which any locomotive boiler has been driven.

The conclusion to be drawn from the tests of Series B concern evaporative efficiency and capacity. The results show that the Jacobs-Shupert boiler and the radial-stay boiler, under all the various conditions of the tests, operate at practically the same efficiency. There are indications that under very high rates of power the Jacobs-Shupert boiler has some slight advantage.

Two boilers of the same efficiency will generate equal amounts of steam for equal quantities of fuel consumed. Relative steaming capacity is in the case of such boilers a matter of relative coal-burning capacity. The superior strength of its firebox allows the Jacobs-Shupert boiler to be fired to very high limits of power without injury. Its strength thus becomes an indirect factor in extending its capacity. In this respect, the capacity of the Jacobs-Shupert boiler excels that of the radial-stay boiler.

Personals

S. A. Cameron has been appointed auditor and general superintendent of the Alabama Central R. R. with office at Jasper, Ala.

J. H. Suhl has been appointed foreman of the Atchison, Topeka & Santa Fe at Las Vegas, N. M., succeeding P. I. Costello.

H. Blake succeeds F. S. Moody as road foreman of engines of the Atchison, Topeka & Santa Fe at Amarillo, Tex.

P. R. Moore has been appointed acting road foreman of engines of the Bangor & Aroostock with office at Houlton, Me.

T. H. Summerkill has been appointed superintendent of motive power of the Central Vermont with office at St. Albans, Vt.

John F. Keefe has been appointed superintendent of the Northern division of the Central Vermont succeeding C. E. Soule. His office is at St. Albans, Vt.

F. J. Byington has been appointed superintendent of the West Iowa division of the Chicago & Northwestern with office at Boone, Ia. He succeeds F. H. Hammill.

F. H. Hammill has been promoted to assistant general superintendent of the Chicago & North Western with office at Boone, Ia. He will have jurisdiction over the following divisions: East Iowa, West Iowa, Iowa & Minnesota, Northern Iowa and Sioux City.

Wm. Garstang.

R. Q. Prendergast has been appointed master mechanic of the Cincinnati, Hamilton & Dayton at Indianapolis, Ind., succeeding W. G. Rose. Mr. Prendergast first entered railway service as machinist apprentice at Benwood W. Va., with the Baltimore & Ohio where he completed his apprenticeship and worked as a machinist. Later he was appointed foreman at Cameron W. Va., with the same road. After holding positions as foreman at several of the largest points on the B. & O. system successfully, he left this road and entered service with the Cumberland Valley Railroad at Chambersburg, Pa., as general foreman and afterwards went with the Delaware and Hudson as general foreman at Carbondale, Pa. While at Carbondale he accepted the position of master mechanic of the Denver and Rio Grande at Pueblo, Col., where he remained for five years. While master mechanic at Pueblo, he was also an active member of the Car Interchange Bureau. From Pueblo he came to Indianapolis as master mechanic of the Indianapolis division of the Cincinnati, Hamilton & Dayton which position he retained until his present appointment.

H. W. Ridgeway has been appointed superintendent of motive power of the Colorado & Southern suceeding H. C. Van Buskirk. His office is at Denver, Colo.

H. W. Ridgeway.

J. T. Gallick has been appointed assistant to the general manager of the Chicago, Milwaukee & St. Paul, with office at Chicago.

G. E. Simpson has been appointed general supervisor of transportation of the Chicago, Milwaukee & St. Paul, with office at Chicago.

G. L. Whipple has been apointed superintendent of transportation of the Chicago, Milwaukee & St. Paul, with office at Chicago.

A. B. Warner has been appointed superintendent of the Southern division of the Chicago, Rock Island & Gulf, with headquarters at Ft. Worth, Tex. He succeeds C. L. Ruppert.

George K. Lowell succeeds R. R. Govin as vice-president and general manager of the Colorado Eastern at New York.

W. E. Anderson master mechanic of the Colorado & Southern has been transferred from Trinidad to Denver, Colo., succeeding H. W. Ridgeway, promoted.

J. M. Davis has been appointed master mechanic of the Colorado & Southern at Trinidad, Colo., succeeding W. E. Anderson. Mr. Davis has been connected with the mechanical departments of the Union Pacific, Kansas City Southern, Midland Terminal, Florence & Cripple Creek and the La Belle Power & Electric Co. He is an active member of the General Foreman's Association and was general foreman of the Denver shops of the Colorado & Southern previous to his present appointment.

C. Corser succeeds G. Geiger as superintendent of the Copper River & North Western with office at Cordova, Alaska.

William Garstang, having served as superintendent of motive power and master car builder of the Big Four for the past thirty years and desiring to be relieved of a portion of his duties, has been appointed general master car builder.

S. K. Dickerson has been appointed superintendent of motive power of the Big Four with office at Indianapolis, Ind.

F. T. Owens succeeds R. Q. Prendergast as master mechanic of the Denver & Rio Grande at Pueblo, Colo.

G. O. Murphy has been appointed traveling engineer of the Denver & Rio Grande, succeeding M. H. Flynn. His office is at Grand Junction, Colo.

A. B. Phillips succeeds W. O. Williams as general foreman of the Denver & Rio Grande at Salt Lake City.

H. D. Noblitt succeeds A. J. Hodge as master car builder of the Fourche River Valley & Indian Territory. His office is at Bigelow, Ark.

G. H. Jenkins has been appointed assistant to the general purchasing of the Grand Trunk with office at Montreal, Que.

Joseph Chidley has been promoted to assistant superintendent of motive power of the Lake Shore & Michigan Southern succeeding S. K. Dickerson, transferred to the Big Four.

O. M. Foster, master mechanic of the Lake Shore & Michigan Southern has been transferred from Elkhart, Ind., to Collinwood, O.

M. D. Franey has been appointed master mechanic of the Lake Shore & Michigan Southern at Elkhart, Ind., succeeding O. M. Foster.

B. F. Kuhn, formerly superintendent of shops of the Lake Shore & Michigan Southern at Collinwood, O., has been made assistant master mechanic at the same place, succeeding M. D. Franey.

B. H. Montgomery succeeds B. F. Kuhn as superintendent of shops of the Lake Shore & Michigan Southern at Collinwood, O.

I. C. Newmarsh succeeds B. H. Montgomery as general foreman of locomotive department of the Lake Shore & Michigan Southern at Collinwood, O.

R. E. French has been appointed master mechanic of the Liberty-White succeeding W. C. Blount. His office is at McComb, Miss.

Chas. H. Morey, Manistee, Mich., has been appointed receiver of the Manistee & Grand Rapids R. R.

H. Shearer has been appointed assistant general superintendent of the Michigan Central at Detroit, Mich.

F. L. Holt has been appointed master mechanic of the Missiouri Pacific at Falls City, Neb. He succeeds J. D. Young.

J. A. Somerville has been appointed superintendent of transportation of the Missouri Pacific system, vice E. F. Kearney, recently promoted to the office of general superintendent of transportation. Mr. Somerville, who is a very efficient railroad man, spent his entire career on the Burlington system until he resigned as superintendent of terminals for that road at St. Louis to become superintendent of terminals at Kansas City for the Missouri Pacific four years ago, which position he has filled ever since until given his present promotion.

Wm. Henke succeeds M. H. Page as master mechanic of the Nezperce Idaho at Nezperce, Ida.

C. E. Cramer has been appointed master mechanic of the San Pedro, Los Angeles & Salt Lake with office at Milford, Utah. He succeeds T. M. Vickers.

Lucius Laudie has been appointed general manager of the Salt Lake & Mercur succeeding A. D. Smith, resigned. His office is at Salt Lake City.

A. Martin has been appointed foreman car repairs of the San Benito & Rio Grande Valley, with office at San Benito, Tex. He succeeds E. C. Reese.

W. R. Meeder has been appointed master mechanic of the Chicago-Eastern Illinois with office at Villa Grove, Ill.

L. A. Hardin succeeds V. W. Anderson as general foreman of the Chicago & North Western at Boone, Ia.

Robt. J. McCaw has been appointed general foreman of the Chicago & North Western at Council Bluffs, Ia. He succeeds E. T. Brenn.

L. W. Lee succeeds Robt. Seabury as foreman painter of the Louisville & Nashville at New Decatur, Ala.

Geo. Rommel has been appointed master mechanic of the Philadelphia & Reading at Wilmington, Delaware.

V. J. Lowe has been appointed foreman of the car shops of the Philadelphia & Reading at Port Reading, N. J.

E. A. Rogers has been appointed storekeeper of the Wabash at Toledo, O. He succeeds C. R. Adams.

W. Canavan has been appointed superintendent of the Wabash shops at Springfield, Ill.

J. F. Green has been appointed assistant master mechanic of the Wabash at Decatur, Ill., succeeding Peter Vosen.

A. W. Blethem has been appointed road foreman of engineers of the Wabash at Springfield, Ill. He succeeds T. N. Lock.

J. A. Barnes has been appointed road foreman of engines of the Wabash at Decatur, Ill., succeeding E. O. Shively.

W. W. Nall has been appointed road foreman of engineers of the Wabash at Peru, Ind.

George McCormick succeeds J. W. Small as assistant general manager of the Galveston, Harrisburg & San Antonio, in charge of the mechanical department. His office it at Houston, Tex.

A. F. Knapp has been appointed master mechanic of the Mexico North Western, at Chihuahua, Chih., Mexico.

James E. Kilborn has been appointed purchasing agent and storekeeper of the Rutland, with office at Rutland, Vt. He succeeds A. E. Douglas, resigned.

W. H. Evans has been appointed master mechanic of the British Columbia division, Canadian Pacific, with headquarters at Vancouver, B. C.

Joseph J. Bennett has been appointed assistant purchasing agent of the Illinois Central, with office at Chicago.

T. J. Lowe has been appointed fuel agent of the Canadian Northern, with office at Winnipeg, Man.

N. L. Smithan has been appointed assistant superintendent of motive power of the Missouri, Kansas & Texas. His office is at Dennison, Tex.

H. D. Jackson has been appointed general master mechanic of the Alabama, Tennessee & Northern, with office at Panola, Ala. He will have charge of the shops at Calvert, Ala.

OBITUARY.

J. A. Bradley, foreman car department of the New York, Chicago & St. Louis, at Buffalo, N. Y., met instant death on the evening of January 4th, 1913, by being run over by a locomotive while engaged in clearing up a wreck at Ripley, N. Y.

Mr. Bradley had been in the employ of the N. Y. C. & St. L. for upwards of thirty years, in charge of the car work on the Buffalo division and as wrecking master. His services were highly esteemed by the officials as he was a man of the highest character, always looking out for the smallest detail of the company's interest. He was at all times just to the subordinates under his supervision and had the best wishes of all those with whom he came in contact in his daily life, being ever ready to accept the call of duty and to assist a fellow-worker as far as was within his power. The funeral, held from his home, 187 Babcock St., Buffalo, N. Y., was largely attended by the officials of the N. Y. C. & St. L. and the multitude of his co-workers in the Buffalo district. The floral tributes in loving remembrance and sympathy were many and numerous, and fully appreciated by his widow and children. Mr. Bradley was 58 years of age, a member of De-Molay Lodge, F. & A. M. No. 498, La Tosca Tent, K. O. T. M. No. 370, Saturn Lodge, I. O. O. F. 928; a charter member of the Central Railway Club of Buffalo, a member of the Chief Interchange Car Inspectors and Car Foreman's Association and an active member of the Niagara Frontier Car Inspection Association. He is survived by his widow and one son and daughter. It is felt the loss of Mr. Bradley to the Chief Interchange Inspectors and Car Foreman's Association will be a keen one as he was ever active in promoting the best interests of the work by his attendance at conventions in company with his wife, who also took an active interest in furthering the work.

J. A. Bradley.

C. E. Gossett, general master mechanic of the Minneapolis & St. Louis, at Minneapolis, Minn., died on February 19. Mr. Gossett was born in Kentucky, in 1869, and received his education at Missouri State University. He entered railway service in 1886 as a machinist helper on the Wabash St. Louis & Pacific. Later he became an engineman on the Hannibal & St. Joseph and on the Chicago, Rock Island & Pacific. He was made road foreman of equipment of the Rock Island, and in 1905 was appointed master mechanic. In 1908, he was appointed master mechanic of the Iowa Central, and in 1910 was appointed master mechanic of the Minneapolis & St. Louis. In January, 1912, he was made general master mechanic of the same road.

C. E. Gossett.

New Books

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION. Proceedings of the eighth annual convention. Paper, 5¾x9 inches, 176 pages. Prepared under the direction of the secretary, Wm. Hall, 829 Broadway, Winona, Minn.

This book covers the annual meeting of the association held at the Hotel Sherman, Chicago, on July 23, 24, 25 and 26, 1913. The following subjects are taken up in these proceedings: "How Can Foremen Best Promote Efficiency," "Railway Shop Management and Systems," "Shop Supervision," "Roundhouse Efficiency," "Shop Specialization, Work and Tools," "The Reclaiming of Scrap," "Utilization of Scrap," "Driving Box Repairs." The subjects show that this association is taking a live interest in all subjects touching on the work of its members.

New Literature

The Union Mfg. Co., of New Britain, Conn., has issued a leaflet descriptive of a ball bearing wrenchless chuck which has just been put upon the market. This chuck has no exposed gears or threads to become clogged and is self-tightening.

* * *

Smooth-On iron cement No. 7 is the subject of a folder recently issued by the Smooth-On Mfg. Co., of Jersey City, N. J. This cement is adapted for waterproofing engine pits, tanks, etc.

* * *

The Standard Electric Tool Co., of Cincinnati, O., has

issued bulletins D-8 and D-9, illustrating and describing its high power electric drills for direct current and for two and three-phase alternating current.

* * *

Bulletin 130 of the Chicago Pneumatic Tool Co., of Chicago, deals with the lubrication of pneumatic tools. It says: "It is a good plan to immerse pneumatic hammers in a bath of benzine or kerosene over night and then blow them out under pressure the following morning, after which they should be thoroughly lubricated with Airoilene. Keeping the tools clean helps the good work of lubrication, and users of pneumatic tools will be well repaid for any efforts they may expend along these lines."

* * *

Tate, Jones & Co., Inc., of Pittsburgh, have published a booklet on the subject of "Blacksmithing and Drop Forging." This is the first of a series of booklets which are to be sent out, all of which will be bound together at a later date. The purpose of the booklet is to place in the hands of the blacksmith or drop forge man a compact volume of facts assembled from the experience of many others engaged in these trades.

* * *

The handsome catalogue recently issued by the Western Tool & Manufacturing Co., of Springfield, Ohio, shows some new and up-to-date ideas in movable benches or portable stands. This firm is equipped to make stands of any kind in either gray iron or sheet metal and has added a fine line of shop furniture, including stands, shop pans, steel racks, etc.

* * *

The Landis Machine Co., of Waynesboro, Pa., has recently issued a very attractive catalogue on Landis threading machinery. It illustrates and describes Landis single, double and triple head bolt cutters, staybolt machinery, pipe and nipple threading machinery, automatic screw cutting die heads, solid adjustable die heads and accessories.

Industrial Notes

Erle C. Cowgill has accepted a position as general manager of a large plantation in Mississippi. Mr. Cowgill was secretary of The M-C-B Co., McCormick Bldg., Chicago, Ill., up to November, 1912, when he disposed of his interest to other members of the company.

Michael Ehret, president of the Ehret Magnesia Manufacturing Company, Philadelphia, Pa., and chairman of the board of directors of the Barrett Manufacturing Company, New York, died at his home in Philadelphia on February 17. He was 75 years of age.

F. R. Wadleigh has opened offices in the Bank of Commerce building, Norfolk, Va., as consulting engineer in all matters in connection with the preparation and purchase and use of coal.

F. H. Allison has been appointed purchasing agent of the American Vanadium Co., and the Flannery Bolt Co., in charge of all office and factory supplies.

Rex Gay, formerly connected with the Ajax Forge Co. and the Sellers Manufacturing Co., will become connected with the sales department of the Verona Tool Works on March 1, 1913.

The Bay State Wheel Co., Boston, Mass., is said to have purchased the plant of the Griffin Wheel Co. in Kansas City, Kan.

The Canada Car & Foundry Co. expects to have the new plant at Fort William, Ont., completed by spring. The Dominion Bridge Co. has begun erection of the steel for the buildings.

The General Electric Co. has received an order from the port and Anacortes, Wash. The Minneapolis, St. Paul, Rochester & Dubuque Traction Co. has also ordered 2 more Great Northern for two 70-foot gas-electric motor cars, which will be placed in service on the line between Rock- gas-electric motor cars.

The National Steel Car Co., Hamilton, Ont., has booked orders amounting to $3,500,000 in 3 months, and has begun delivering cars to the Canadian Pacific on a contract amounting to $1,500,000.

The Republic Iron & Steel Co. has awarded a contract to the Raymond Concrete Pile Co. of New York for placing approximately 1,200 standard Raymond concrete piles for the foundations of open hearth buildings and furnaces at their open hearth steel works, Youngstown, Ohio. The Raymond Co. has recently completed a contract for placing Raymond piles for the foundation of a blast furnace for the same company.

E. C. Hall has resigned his position as consulting contracting engineer with the Worden Allen Co., and has opened offices in Chicago, Ill. for practice as consulting engineer. Mr. Hall has for the past 10 years been in charge of the railway bridge construction department of the Worden Allen Co.

A. B. Chadwick has resigned from his position with the Armour Car Lines at Meridian, Miss., to accept a position with the Grip Nut Co., Chicago, as superintendent of its plant at Whitney, Ind.

The Brier Hill Steel Co. has awarded contracts for machinery for its new steel plant at Youngstown, O., including coal handling and crushing machinery to Heyl & Patterson, of Pittsburgh, Pa.; switchboard for power house, and electric locomotive for handling hot metal in the open-hearth department, to the General Electric Co., and complete electric controller equipment with the Westinghouse Electric & Mfg. Co.

Petitions in bankruptcy were filed February 18, against the General Railway Equipment Co. and the United States Electric Co., a subsidiary. The former was incorporated under the laws of Maine, authorized capital stock $15,000,000. The subsidiary was organized as a West Virginia corporation with an authorized capital stock of $400,000.

The Griffin Wheel Co., Chicago, has been reincorporated under the laws of Massachusetts, and has increased its capital stock from $10,000,000 to $21,000,000, of which approximately $15,000,000 has been issued. The company has been an Illinois corporation.

It is said that arrangements have been concluded for financing the construction of the Coffeyville, Caney & Southeastern, which proposes to build a line from Coffeyville, Kan., through Nowata, Centralia & Vinita, Okla., to Siloam Springs, Ark.

The Greenville & Knoxville, it is reported, will soon undertake the extension of its line, now 23 miles long from River Falls, S. C., to Sevierville, Tenn., where connection can be made with the Knoxville, Sevierville & Eastern.

A portion of the Great Northern extension from Snowden, Mont., to Sidney, Mont., is in operation for the handling of freight, a tariff being made effective from Snowden to a point about 30 miles south.

There are prospects that the Georgia & Florida will take up shortly the construction of its projected extension from Augusta, Ga., to Columbus, S. C. The company has just been reorganized.

Plans are being considered, it is reported, for an extension of the Fort Smith, Subiaco & Eastern to Dardanelle, Ark., either 26 or 29 miles, depending on which of two routes is selected.

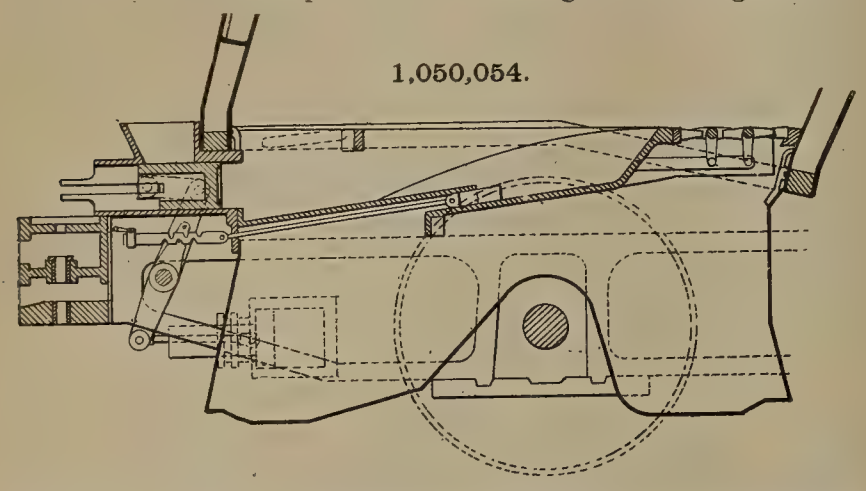
The Durham & Southern is said to be planning an 18-mile extension from Dunn to Newton Grove, N. C.

Recent Railway Mechanical Patents

STOKER.

1,050,054—David F. Crawford, Pittsburgh, Pa.

The object of the invention is to provide an improved means for regulating the feed through the feed trough; an auxiliary feeding means whereby the supply of fuel to the sides of the furnace may be controlled independently of the main feed, and means whereby the fuel in the trough is caused to spread laterally. The primary feeding member is the piston, which is mounted for reciprocation beneath the hopper and is operated from a shaft by means of cranks and connecting rods. The shaft is oscillated from a steam cylinder at the side of the fire-box. Secondary or auxiliary feeding means are provided for the trough in the form of the two pistons working through the bottom of the trough as indicated in the figure, and located on opposite sides of a dividing wall which has flared sides in order to assist in giving the coal a lateral feed at this portion of the trough. The length of the

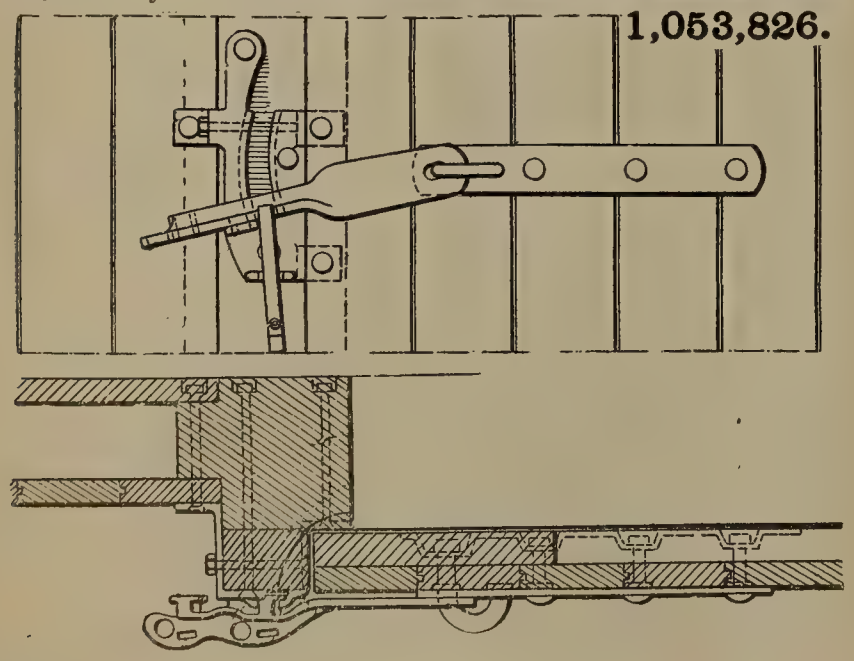


piston stroke can be regulated by means of notches and pins. The use of the two pistons placed side by side upon opposite sides of the partition is advantageous in that it provides for the increase or decrease of the supply of fuel to the sides of the furnace when found necessary.

SLIDING DOOR FASTENER.

1,053,826—Bartholomew Julien, Omaha, Nebraska, assignor to Grip Nut Company, Chicago, Ill.

This provides means by which the sliding door of a freight car can be fastened, locked and sealed either in an entirely closed position or in a partially open position, as occasion demands. In the practical use, the door is arranged in fully closed position, or in partly open position, as desired, and then the latch is swung downward so that the particular tongue that is presented to the channeled portion of the keeper is moved downward in the keeper until the latch portion brings up against the keeper lug when the fastener may be locked and sealed in the usual manner. When

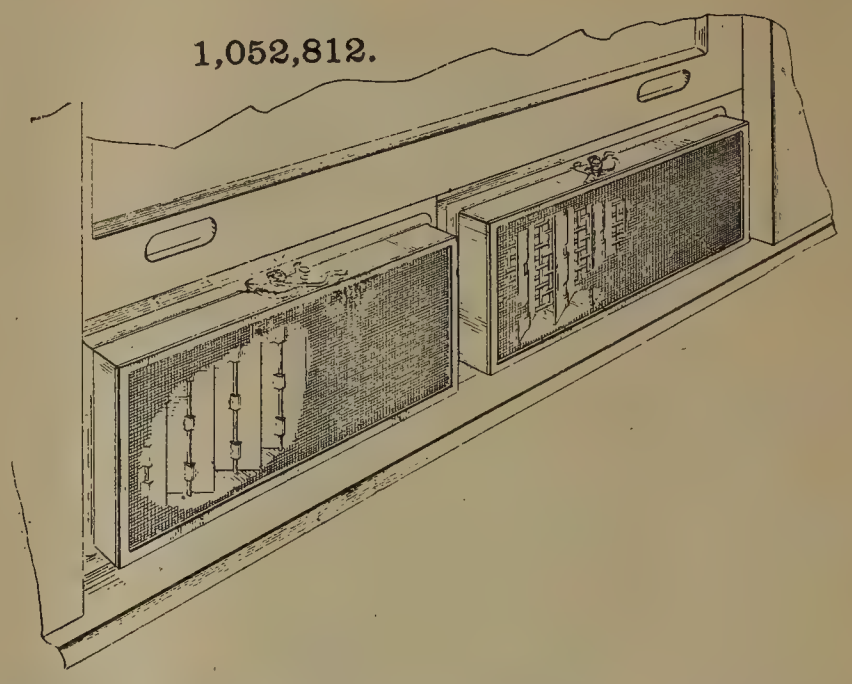


it is desired to open the door, the lock is opened and the seal broken, after which the latch is swung upward to carry its tongue out of the keeper, when the door and latch may be freely moved toward the right. By reason of the provision of the flange on the vertically disposed portion of the latch, and the provision of the apertured lug on the keeper, it will be observed that when the door is latched in closed position, the flange rests on the lug with the result that when a pad lock is employed to connect the latch and the lug, the shackle of the lock is not subjected to any strain whatever. It will also be observed that the provision of the flange on the latch enables the seal to extend directly down from the latch to the apertured lug on the keeper, which is advantageous inasmuch as it facilitates the sealing of the latch.

VENTILATOR AND SCREEN.

1,052,812—Thomas H. Garland, Chicago, Ill.

This device can be inserted between a window and its sill and may be adjusted to control the air flow in either direction through the window opening or to entirely close the opening. It will also substantially prevent the entrance, with the air, of heavier particles such as smoke, soot, dust, or cinders, yet will allow the

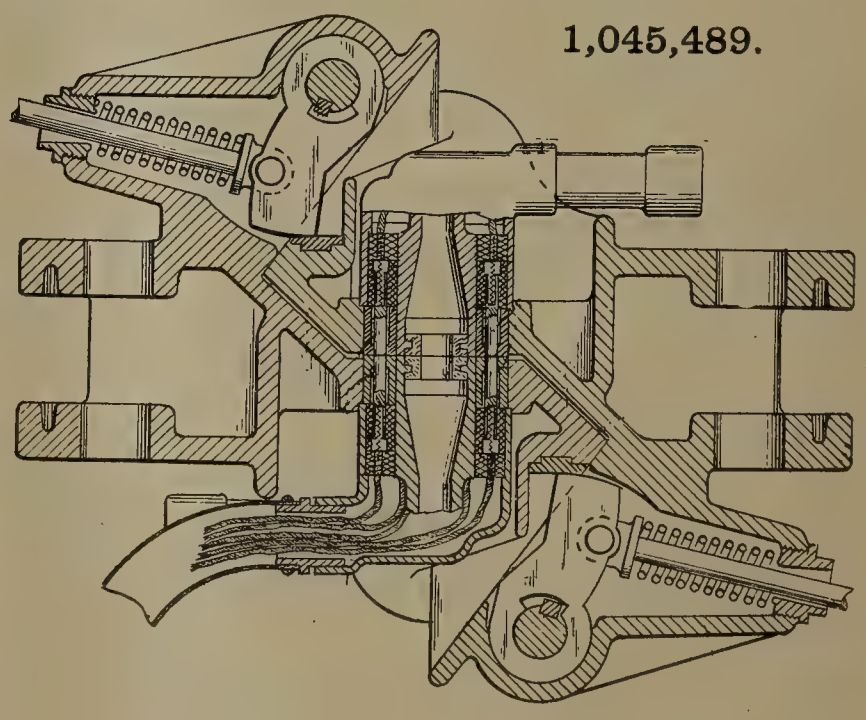


clean air to enter and may be used efficiently in connection with main ventilator mechanisms for railway coaches and buildings to more efficiently control the ventilation. The vans or louvers when set as shown in the advance section will scoop up the air entering through the grill-work and will deflect it into the car, while the vanes if set as shown in the rear section, will tend to deflect outwardly the air which strikes them and particularly to deflect outwardly the more solid particles, such as smoke and cinders. These vanes will also tend to cause air flow from the interior of the car to the exterior. The screen strains out the particles from the inflowing air.

AUTOMATIC CAR COUPLING.

1,045,489—Harry F. Woernley, Allegheny, Pa., assignor by mesne assignments to H. H. Westinghouse, New York.

One of the objects of device is to improve the arrangement of the electrical contact terminals with reference to the fluid pressure conduits, whereby space and material are economized and a more efficient electric coupling secured. Another object is to provide a hand operated device at the side of the car or upon the platform, and connections from said device to the cock or cocks of the fluid pressure conduits and to the lock release of the coupler, whereby when applied to a mechanism having a pivoted or swinging draw bar, the device may be manipulated at any time



to either open or close the fluid pressure conduits or to release the lock of the coupler, as desired. The illustration is a central horizontal section showing the two counterpart members in coupled position. The projecting portion of each coupler head enters the recess of the other, depressing the locking levers until the hooked portions pass one another, whereupon the springs force the locking levers with their cam-shaped end faces out into engagement with the corresponding curved surfaces in the notches of coupler heads. This presses the two counterpart members together with the gasket openings of the fluid pressure conduits in register and the terminal plungers of the electric conductors making contact with each other.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
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Communications on any topic suitable to our columns are solicited.
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LOCOMOTIVE LABORATORIES.

On another page we publish a description of the new locomotive laboratory and testing plant being completed at the University of Illinois. This makes a total of five locomotive testing plants in this country, of which the one at Purdue University is the oldest and perhaps best known. Other plants are located at Columbia University, at the Chicago & North-Western shops and at the Altoona shops of the Pennsylvania. It is notable that three universities and but two railways are so equipped.

In the design of this laboratory, a study has been made of all existing laboratories and an effort has been made to overcome any defects and improve on the present plants wherever possible. The capacity of the dynamometer used at the University of Illinois is said to be about four times that of the one installed at present at Purdue, and it can, with a safe margin, take care of the most powerful engines now in use. In fact, the margin is such as to allow for quite a substantial growth in the size of locomotives.

What good does it do? Where do the railways earn any dividends from it? That depends somewhat on the University of Illinois and more on the railways. The testing plant cannot take the place of the practical road test, as long as locomotives keep rolling about the country. And the converse is true; the practical test cannot supplant the work of an efficient testing plant. The two must be made to work together. Our universities are changing from universities of higher learning to universities of broader learning. They are coming down from the top to the base of the hill, where they are readily accessible. This is the opportunity of the University of Illinois to make itself more of a power among western railways and indeed among the railways of the country. We are confident that the University of Illinois will do its part with its able and willing faculty, its new and improved facilities and its favorable location. Purdue and Illinois are probably the strongest and best equipped in the railway department of any of our universities. The work being done, and to be done, by their laboratories is of great value.

We are not paying the attention to the efficiency of our locomotives that we should. Industrial plants are constantly running efficiency tests on their motors, their pumps, their steam engines, their gas engines, their batteries; but we are content to give our locomotives a test now and then. The only way to tell what a locomotive should do is to put it in the locomotive laboratory, hitch it to the dynamometer and run it. And efficiency is spelled with capital letters nowadays. It is true that such a test is run under ideal conditions; it is true that many other factors affect the locomotive's performance on the road. But it shows what the locomotive is capable of doing; it sets a standard and it also gives a basis for comparison. If a test is carefully run in the locomotive laboratory and the engine is then given a road test, a study of the results of the two will give an accurate estimate of that engine's efficiency.

The men in charge of locomotive laboratories are willing and eager to do what they can, but the burden rests with the railways. Will they take advantage of the facilities which are afforded them? We have always believed in a testing plant for the benefit of all the railways or at least for those in a certain group. It is not feasible or efficient for one road to maintain

an expensive testing plant itself, but a testing plant serving all the roads or a number of plants scattered about the country to serve different groups could do effective work for each road with a minimum of expense. It would enable many roads to know much more definitely what they were getting from their power, and this knowledge might prove very profitable. Furthermore, with the wider range of work a number of interesting comparisons would be afforded. And the work of such laboratories need not be confined to locomotives, but could include experimental work on all manner of equipment. The roads in the territory served could contribute pro rata to the support of such laboratories.

The University of Illinois is inviting and urging members of railway clubs and railway men generally to be present at the opening of the new laboratory. It is to be hoped that they will respond. Locomotive laboratories have done and will continue to do much good. They will help the railways to earn dividends if the railways will give them the encouragement and support they need. It is up to the railways; will they take advantage of the opportunity? Or must those in charge of the testing laboratories go after the roads and persuade then to center their efforts along these lines at one or more laboratories?

ELECTRIFICATION.

Two recent announcements bearing on the electrification of railways have given the movement considerable impetus. One of these announcements—that of the Chicago, Milwaukee & St. Paul—is of particular interest in that it refers to the projected electrification of four hundred and forty miles of main line in its mountain district. From the viewpoint of the engineer this is by far the most important project of its kind in this country, as the decision for electrification was reached by those concerned unhampered by any of the multitude of political, sentimental, and fancied issues which must be taken into consideration with the planning of operative changes in congested districts. In other words, there was probably little argument offered either pro or con which did not deal with the problems of economical, efficient operation.

The announcement of the Pennsylvania to the effect that the Philadelphia division of that road will be electrified is also of considerable interest, but this class of project has become more or less a conventional one. Heavy passenger traffic in a congested district, where smoke is seriously objectionable, presents the problems met and overcome in several electrifications which have, from certain viewpoints, proved successful. It is highly probable that the Pennsylvania will at an early date operate its trains from Philadelphia to New York without change from electrical power, and as an indication that still further electrifications may be expected on this road, the Pennsylvania has established a correspondence school of electricity for the education of its employes. It is realized that both trainmen and shop men must be schooled in the elements of electrical engineering if the management is to continue its policy of making its own officers and men. That the men themselves appreciate the situation is evidenced by the interest shown in the new course of instruction. It is said that over 10,000 persons have enrolled as students.

The electrification of the Milwaukee road through the mountains will utilize the water power available along its lines and at the same time it will solve the fuel question which has caused considerable difficulty in the far West. Lignite coal of an inferior grade has been about the only available fuel for locomotives in the mountain district except at the expense of costly haulage. The increase in track capacity, an argument long used by electrical engineers, is a question yet to be decided in projects of this nature. The electric system to be used on the Milwaukee, as well as on the Denver & Rio Grande, which has a project of similar nature under consideration, is yet to be decided.

An apparent anomaly in the recognition of the superiority of electrical power over steam by lines operating under the two extremes of conditions—congested districts in the East and sparsely settled districts in the West—is easily explained. The two classes of service have no similarity, notwithstanding many opinions to the contrary, but certain difficulties, widely different in nature and only solvable by electrification, have presented themselves in each case. The same conditions may be expected to result in further electrification of extensive nature to be started during the present year.

STAYBOLTS.

An investigation of the Russian railways into the causes of deformation of firebox walls and staybolt breakage, has been conducted by M. V. Gololobov and reported to the International Railway Congress. Elaborate testing apparatus was used for studying the subject and all stays used in the tests were .984 in. in diameter in the threaded section. In certain cases the stays were tested without heads to determine the resistance of the threads alone, and in others stays were used with heads and no threads to determine the resistance of the heads alone.

In the tests without heads it was found that the resistance to shearing per square millimeter of surface diminishes as the plate thickness increases; this is explained by the fact that the thinner plate buckles, enlarging the opening, the conditions of shearing the upper threads of the bolt changing with the amount of gaping.

In the tests of stays with heads and no threads, it was found that there is a tendency toward reduction of the shearing resistance per square millimeter of surface in proportion to diminution in plate thickness. It was definitely ascertained that the resistance of the plates, where stay heads are used, is about double that of the threads.

These facts are of utmost importance in firebox design and it is possible that similar investigation has warranted the practice of the Canadian Northern Railway in depressing the sheets on the fire side of the fireboxes at each stoybolt hole, thus making the rivetted head of the bolt flush with the general surface. This method increases the threaded surface without detracting from the holding power of the head. An added advantage is the ease with which the staybolt head can be efficiently caulked, the head resting in a depression presenting an excellent caulking edge around the rim of the depression. This method of preparing the plate required the development of special tools. The plate is first perforated with a 7-16 in. punch, followed by a 12 in. reamer. The sheet is then annealed, prior to the depressing process. A punch and die is employed for the depressing, the

nose of the punch forcing itself through the ½ in. hole, thus drawing out the plate and allowing a larger threading area.

NECESSARY AND UNNECESSARY EXPENDITURE.

Elisha Lee, chairman of the Eastern Railroads' Committee, at present arbitrating a wage controversy with their firemen, in summing up the case of the companies gave the following indication of the present policy of the railroads in regard to the many needless expenses imposed on them by various agencies of the public. He said:

"Since these arbitration proceedings started, the situation of the railways has undergone great changes. The most startling of these has been through the floods in the Middle West. The meagre accounts in the press of what happened give but faint notion of the real disaster. In forty-eight hours six inches of rain fell, developing floods in Ohio and Indiana fourteen feet higher than anything ever known before. The entire railway system of Ohio and Indiana was practically put out of business for five days. On the Pennsylvania Lines West of Pittsburgh an aggregate of a mile and a half of steel bridge work was washed away; and we understand the New York Central and B. & O. will each have to pay out more than $3,000,000 in repairs to property alone. To repair and replace the railways affected by this disaster will practically wipe out the surplus earnings of many railroads. In other cases dividends will be threatened. The reason is, of course, that all such damage must be retrieved out of current earnings and cannot be charged to capital."

There was never a more striking nor more unexpected object-lesson of the absolute necessity for a railway company to earn a surplus adequate to protect its credit and enable it to take care of expensive emergencies.

When the public, through commissions, through mandatory legislation or through arbitration under the law, assesses additional payments to be made out of railway revenues, that same public in effect levies an additional tax upon itself—unseen and intangible for the moment, perhaps, but inevitable in its effect.

This public little realizes how agencies acting presumably in its behalf are piling up the burdens on the railroads. That public dimly imagines that it is the capitalists of Wall Street who are being injured.

But it is not so. The railway managers of the country are fighting the battle of the public—that public which is entitled to have efficient transportation facilities at reasonable rates. It is entitled to enjoy rates based upon real capital invested. It should pay rates which will yield proper wages to railway labor and a sufficient return upon the capital necessary to provide proper facilities.

SUPERHEATER PACKING.

The advent of the superheater has, as is usually the case with a new device, brought with it a number of questions and problems. One of these is the question of packing. The high temperatures induced by superheat has caused more or less trouble with the packing hitherto in use, and a number of roads have been experimenting with various forms of packing in an attempt to produce more satisfactory results. The ordinary packing melts and disintegrates under the high degree of heat, and brass and iron packing rings are reported as giving satisfaction in some instances. Considerable experimentation is being done both by the packing companies and by the railways, however, in an effort to evolve a more satisfactory packing. We would be glad to hear from our readers as to their experiences along this line and as to any experiments which they have made which seem to solve the problem. Questions of this sort can be worked out more quickly and satisfactorily by discussing them and by each man telling of the efforts which he has made. Are you having any difficulty with superheater packing?

LOCOMOTIVE SUPERHEATING IN ENGLAND.

By Thos. Reece.

Consideration of locomotive superheating problems continues in the United Kingdom and recently two members of the British Institution of Mechanical Engineers gave details of their study of some effects of superheating and feed water heating on locomotive operation. They pointed out that the fact that there was a rapid increase in the boiler losses at the higher rates of firing showed that improvement would be realized if the necessary output could be secured by some means at a reduced rate of firing. Within limits, increase in boiler capacity was thus as logical from this point of view as it was when made in order to meet demands for more power. This solution, however, had certain drawbacks. With the enlargement, radiation and grate losses increased, the latter becoming important in intermittent work. An increase in total engine weight was also involved, and as this was limited by permanent-way considerations, the time would come, and had now been reached in some cases, when improvements must be sought, involving an increase of weight on a reduced scale. The logical alternative to the increase of boiler capacity was to relieve the boiler of part of its work by the adoption of some supplementary process which, however, to be successful must necessitate a comparatively small increase in weight. Two processes which met the requirement were feed-water heating and steam superheating.

In feed-water heating part of the boiler work was accomplished before the water passed the check valve. For feed-heating agents, providing a direct saving of otherwise waste heat, there were available the exhaust steam discharged from the cylinders and the waste gases passed out of the chimney. Feed-heating could be accomplished by either of these alone or together in series. If used in series, heating by the waste gases must be accomplished last. As the process might be arranged to result in temperatures being reached at which even the so-called hot-water injectors would not work, its successful adoption involved a reconsideration of the feeding system generally.

In superheating, a final benefit might be due to different causes according to the system. In one system, the heat in the waste gases discharged from the boiler was utilized to raise the temperature of the steam. In another, a directly-fired superheater was employed, commonly incorporated for convenience in the boiler, in order that one grate might serve both. Hybrid systems had also been tried, in which either the ordinary boiler tube length had been curtailed and a superheater added in the space thus provided, or a large supply of "live" gas had been conducted to a smoke-box heater through a special flue. Most of these latter systems had been abandoned. They lowered the efficiency of steam generation and this was not sufficiently recouped in the engine for these arrangements to compare favorably with others.

Contrary to general experience in other branches of steam engineering and also in conflict with testimony from many railways, it has been maintained that waste-gas superheating effected little or no benefit in locomotive work. This system combined improvements in two directions—namely, in the efficiency of steam generation and in the engine's consumption.

The gain in generation had been commonly ignored or

actually denied so far as locomotive work was concerned, while the engine gain had been fairly generally admitted. A true waste-gas superheater formed an adjunct to the ordinary boiler, and its installation should not disturb the heating capacity of the boiler nor alter its efficiency. About the same proportion of the heat of combustion was taken up by the water heating surface as where no superheater was fitted and to the steam thus produced was added further heat, abstracted from the waste gases. The overall efficiency of the generator was improved, and the proportion of heat available in the coal, put to use, was increased. Directly fired superheater locomotives, using superheat from 100° F. upwards which could lay claim to no improvement in the efficiency of steam generation, but rather suffered in an adverse sense, admittedly proved satisfactory in service. There appeared, therefore, to be no valid reason why the waste-gas heating system, with which superheat of about 90° F. could be obtained, should not likewise give good results. The difference between the temperatures just cited was more than made up by the higher overall efficiency of the combined waste gas heater and boiler. The temperatures claimed for waste-gas superheaters were sometimes too high, but something over the figure just quoted was, however, perfectly practicable.

In regard to efficiency of steam generation, the combination of the waste gas superheater and boiler ranked first. Probably the ordinary boiler ranked second and the high degree smoke-tube superheater boiler third, but this did not appear yet to have been definitely determined; it was possible their relative positions were not the same at all powers. Last of all stood the moderate-degree smoke-tube superheater boiler. Though the above aspect of superheating was often treated with indifference, it was generally conceded that there was more or less saving in steam at all degrees of superheat. Even with no superheat the use of a heater might reduce the feed necessary if the steam normally sent over was wet, and part of the economy shown on road tests undoubtedly arose from this. With any temperature above that corresponding to dry steam there was an improvement in the engine. In stationary work this was not disputed and the result was similar in locomotive working.

Among others, two long series of trials of the class of installation, giving moderate degree feed-heating and moderate superheating by waste gases had been conducted on the Egyptian State Railways. The most important was carried out in 1911, though the system had then been in actual operation for some time on a comparatively large scale. The heaviest scheduled trains between Cairo and Alexandria, having average speeds deducting for stops of between 42.4 and 43.3 miles an hour, with loads usually above 330 and frequently over 400 tons tare behind the tender, were operated. The heater engine, No. 706, five sister-engines without heaters, and one engine of the same class (No. 712 as then fitted) with a high-degree superheater and piston-valves, were all run in one link, working with three De Glehn compounds. The latter engines now usually handled these trains. They had cylinders 13¼ inches and 22 inches by 25¼ inches, total heating surface of 2,365.5 sq. ft., working pressure of 228 pounds per sq. in., and total weight, with tender, of 107.25 tons (of 2,240 pounds each). The engines of the 706 class weighed some 20 tons less. Engine No. 706 proved the most economical of the whole link, and showed 38.8 per cent economy over the non-heater engines and handled throughout the heaviest trains. It showed an economy of 20 per cent on the De Glehn compounds.

Another test was interesting, though made with a lighter class of engine fitted with a type of installation since greatly improved upon. These trials covered the service operation of the Upper Egypt expresses for a period of over two months, extending to 88,480 train miles, run by 16 heater and 18 non-heater engines. The coal economy per ton mile varied in these trials for the heater engines from 22.1 per cent to 25.5 per cent, with an average of 23.7 per cent for the whole test. On light trains in a section with three stops only, the non-heater engines took 36.7 pounds of coal a mile, and the heater engines took 28.4 pounds. For similar trains in another section with 13 stops and seven slackenings, the consumptions were 42.9 pounds and 33.5 pounds respectively, the heater engine taking 5.1 pounds extra a mile, but the non-heater 6.2 pounds extra. For the heavy trains, the difference was increased. For trains of 337 tons tare behind the tender, the non-heater engines took 38.4 pounds in one section; but in another they took 47.1 pounds, a difference of 8.7 pounds, while the heater engines took 30.6 pounds and 34.4 pounds, a difference of 3.8 pounds.

COAL STORAGE AT PANAMA will be within large basins made of reinforced concrete in which half of the coal will be stored under water. There will be a basin at Cristobal with a capacity of 290,000 tons and another at Balboa with a capacity of 160,000 tons. It is possible that parts of the storage basins will be leased to private coaling companies but all the handling is to be done by a government plant. The Cristobal plant will be capable of unloading 1,000 tons and loading 2,000 tons each hour, and the Balboa plant 500 and 1,000 tons.

FIRING UP LOCOMOTIVES at the London terminus of the Great Western Ry. (England) is aided by a portable oil apparatus, which consists of two tanks, one containing oil and the other compressed air. A flexible hose leads from the oil tank to a sprayer inserted through the fire door, which thoroughly atomizes the oil and covers the dead coal with flame. It is especially useful in thickly congested districts, where the usual methods of firing up result in clouds of dense smoke.

A SAFETY RALLY was held in Exposition Hall, Pittsburgh, on March 10, which was participated in by employees of the Pennsylvania, the Buffalo, Rochester & Pittsburgh, the Baltimore & Ohio, the Bessemer & Lake Erie, the Pittsburgh & Lake Erie, the Wabash-Pittsburgh Terminal, and the Union Railroad.

THE STUFF.

The test of a man is the fight he makes,
The grit that he daily shows;
The way he stands on his feet and takes
Fate's numerous bumps and blows.
A coward can smile when there's naught to fear,
When nothing his progress bars,
But it takes a man to stand up and cheer
While some other fellow stars.

It isn't the victory, after all,
But the fight that a brother makes;
The man, who, driven against the wall,
Still stands up erect and takes
The blows of fate with his head held high,
Bleeding and bruised and pale,
Is the man who'll win in the by and by,
For he isn't afraid to fail.

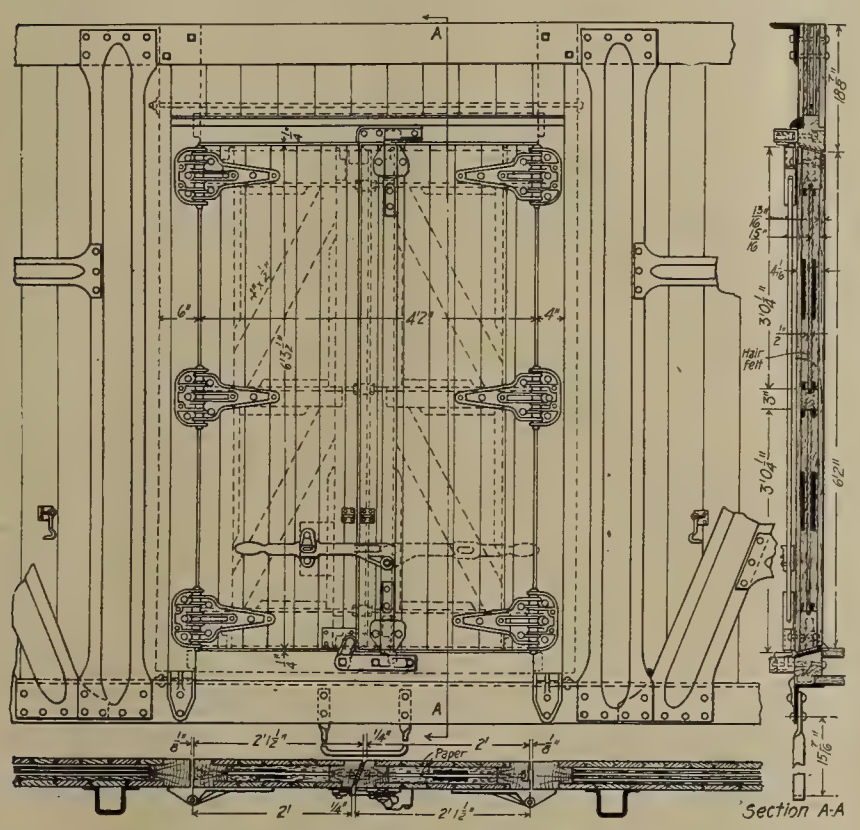
It's the bumps you get and the jolts you get
And the shocks that your courage stands
The hours of sorrow and vain regret,
The prize that escapes your hands
That test your mettle and prove your worth;
It isn't the blows you deal,
But the blows you take on the good old earth
That show if your stuff is real.

—*Exchange.*

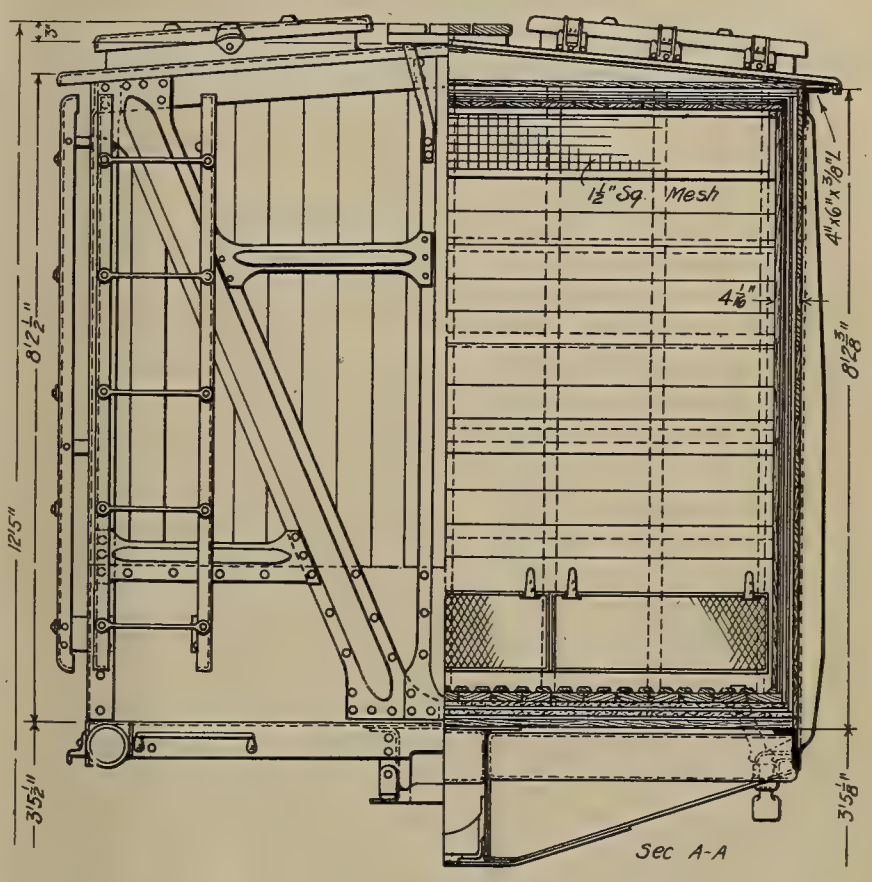
Refrigerator Cars, Pennsylvania R. R.

Nearly 7,375 freight cars of class X-23, X-24 and R-7 types have been ordered by the Pennsylvania during the past few months. An order for 1,000 class X-23 cars was placed with the Altoona car shops last fall and since then 3,000 X-23 and 1,000 class X-24 cars have been ordered from the Pressed Steel Car Co. Class R-7 is a refrigerator car of new design, for which orders have recently been placed. One thousand of these cars are being built by the American Car & Foundry Co., and 7,375 are being built at Altoona. We publish herewith a number of drawings which illustrate the principal features of these cars.

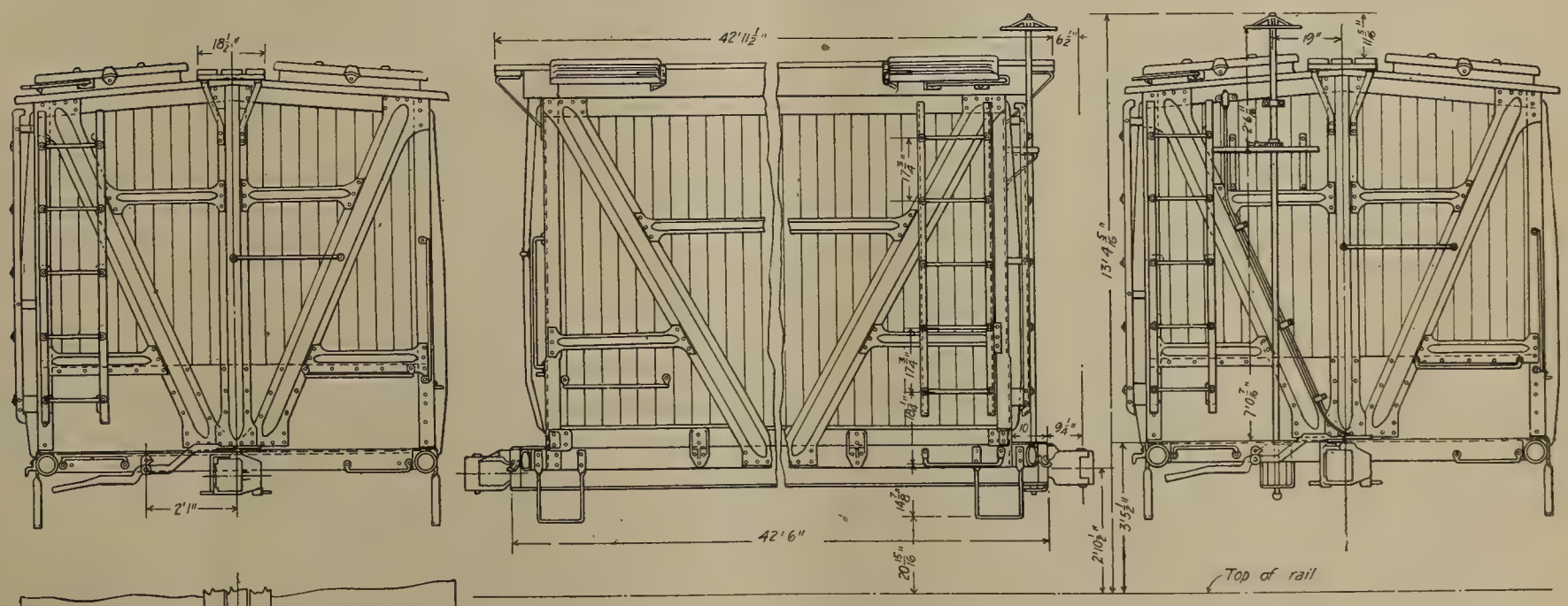
The class R-7 refrigerator cars have a capacity of 90,000 pounds, and have ice bunkers with a capacity of 10,000 pounds. The length over all is 42 ft. 6 in., width over all, 10 ft. 1 in. and height from rail to running board 12 ft. 5 in. The length inside is 32 ft. 11½ in., width inside 8 ft. 4⅜ in. and height from floor to ceiling 7 ft. 4 in. The inside and outside sheathing is $\frac{13}{16}$ in. yellow pine. The insulation consists of 2 plys of waterproof felt paper weighing not less than 410 pounds per 1,000 sq. ft., and 3 plys of Keystone ½ in. hair felt. The flooring

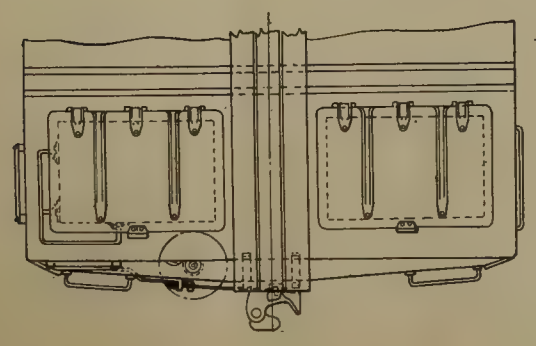


General Arrangement of Side Doors, Penn. Cars.

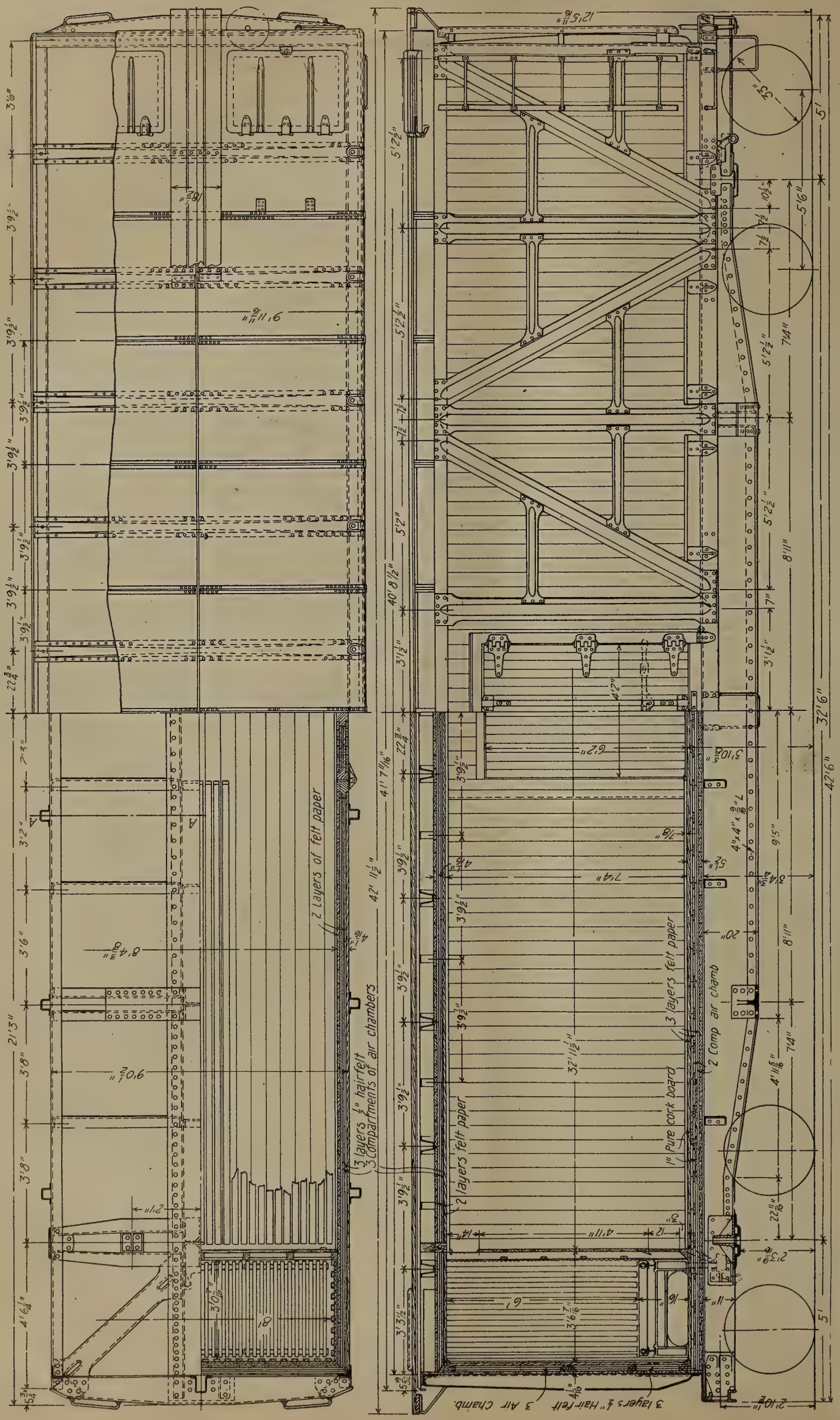


End View of Pennsylvania Refrigerator Cars.

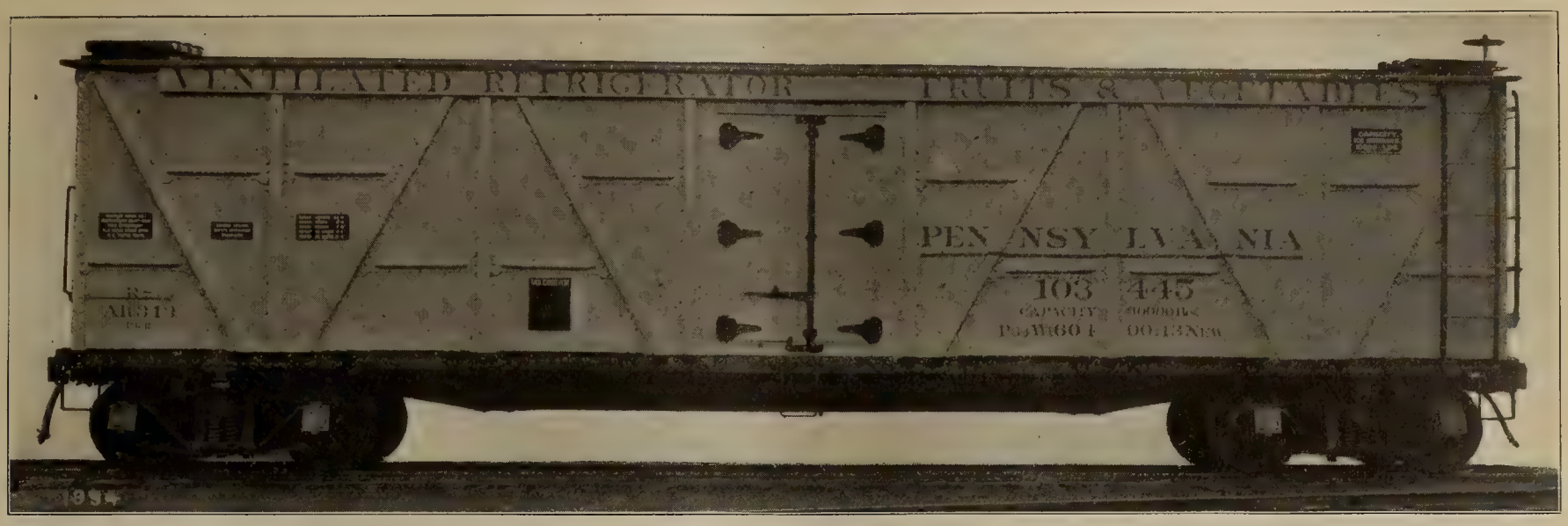




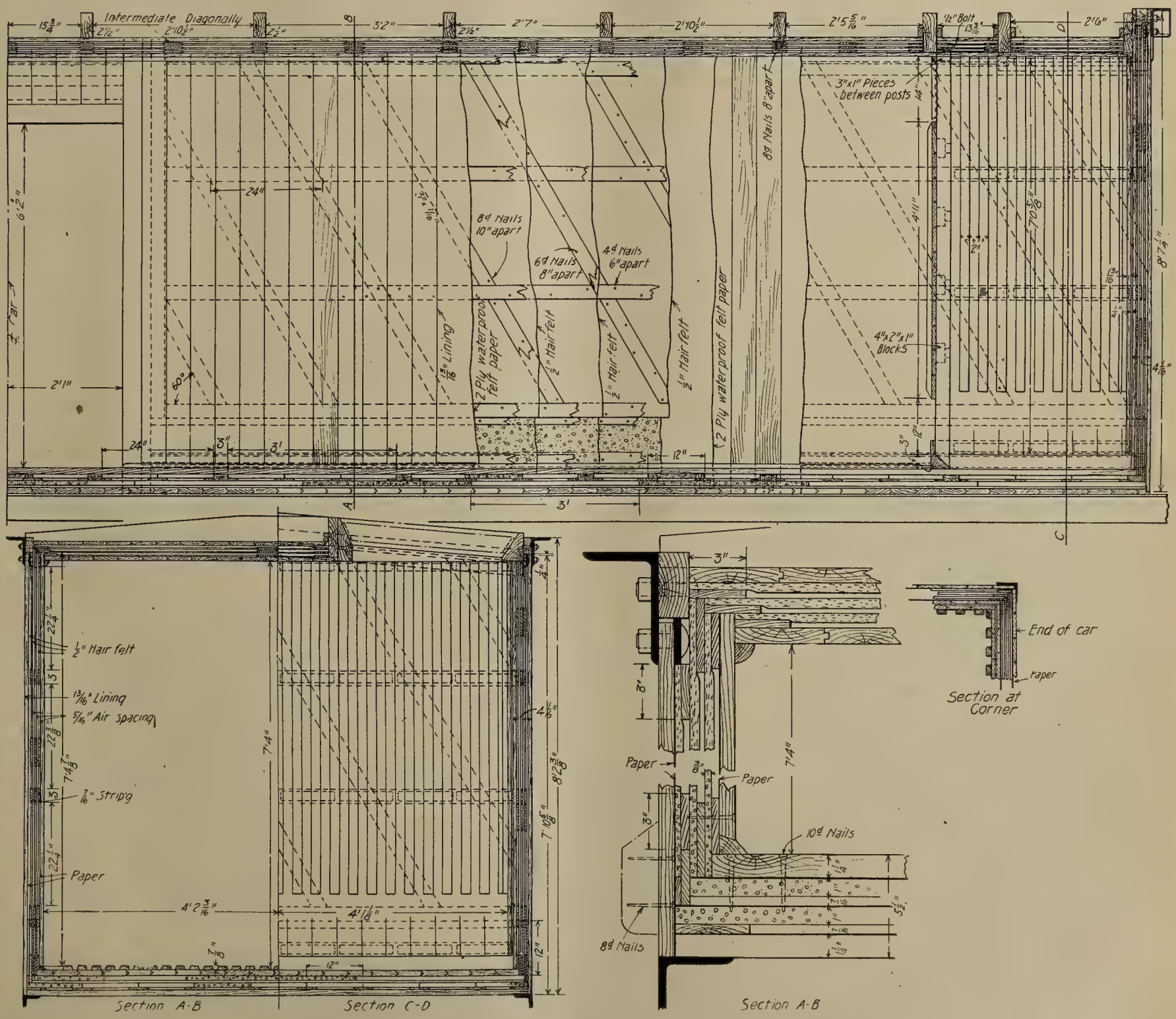
Application of Safety Devices to Pennsylvania Refrigerator Cars.


2 layers of felt paper
3 layers ½" hairfelt
3 Compartments of air chambers
3 layers felt paper
2 layers felt paper
1" Pure cork board
2 Comp air chamb
3 layers felt paper
3 layers ½" Hair felt 3 Air Chamb.

General Arrangement of Pennsylvania Class R-7 Refrigerator Cars.



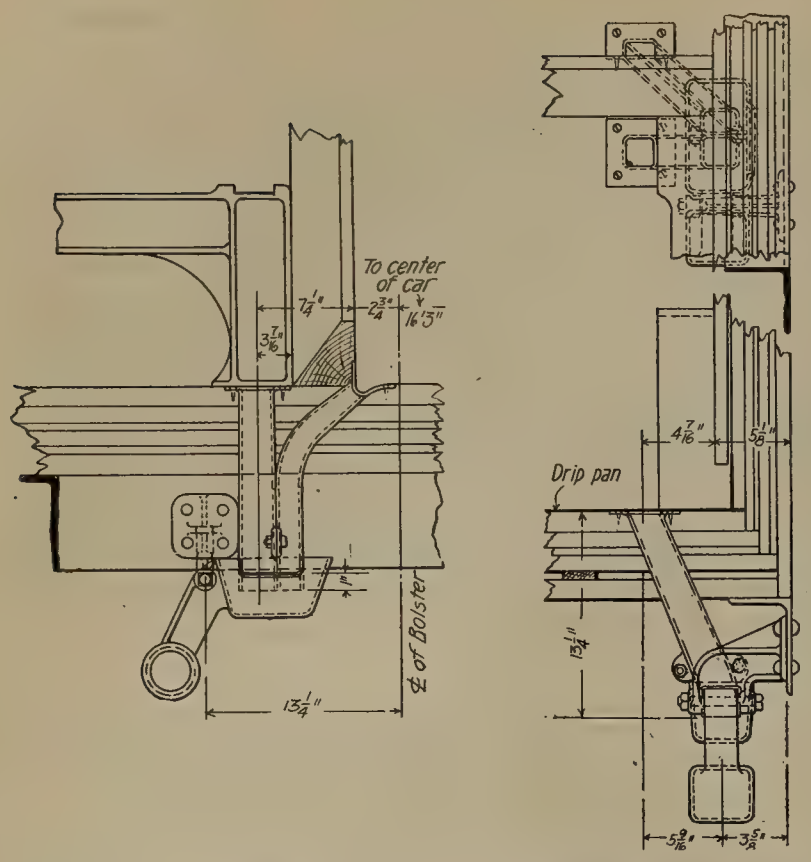
Pennsylvania Class R-7 Refrigerator Cars.



Showing Application of Insulation on Pennsylvania Class R-7 Refrigerators.

consists of 1¼ in. yellow pine on the top and bottom courses, with 2 plys of 1 in. cork and 3 plys of waterproof felt paper intervening. All flooring joints are white leaded. The arrangement of the water trap and drain pipes is shown in the sketch. Roof seams are riveted and have inside and outside butt strips. There are ten carlines made of ¼ inch steel pressed "U" shaped. The doors have a clear opening 6 ft. 2 in. by 4 ft. 2 in. and are equipped with Miner operating rods.

The underframes are of the fish belly type without bolsters. Center sills are ⅜ in. thick, 20 in. deep at centers and 11 in. at



Arrangement of Water Trap and Drain Pipes, Pennsylvania Refrigerator Cars.

draft. Side sills are composed of ⅜ in. x 4 in. x 6 in. angles, and there are two needle beams spaced 8 ft. 11 in., equi-distant from the center of the car. The cars are equipped with Westinghouse draft gears and P. R. R. standard arch bar trucks.

WHY SAFETY FIRST CANNOT FAIL.

A Talk by R. C. Richards, General Claim Agent, C. & N. W. Ry., Before the Western Railway Club.

I am very much surprised to hear one of the gentlemen who preceded me or anybody else talking about the safety movement failing. There is not one chance in ten millions of it failing. It cannot fail, because the safety movement is right and nothing that ever was right failed. The safety movement appeals to the men, because it prevents their getting hurt. It appeals to their families, because it saves them from poverty and suffering and destitution. It appeals to the practical everyday man who runs the railroad and the shop, because it increases the efficiency of the organization and makes it more economical and profitable to him. It appeals to the man of imagination, because anything that is human, that tends to the conservation of human life, appeals to any man that has imagination, and we all have some imagination. There is no movement in the annals of railroad history that has ever spread so fast and so far in the same time as the safety movement. In two short years it has gone from the Atlantic to the Pacific, it has gone from the Gulf to the Great Lakes and it has reached over and touched Japan, because over there in Japan even they have copied the North Western safety organization and they have copied it because the vice president of the Imperial Government Railway of Japan says the North Western men have accomplished such miraculous results that they want to adopt it in Japan.

Now, nobody who has any connection with the safety movement ever ought to say, or ever ought to think there is a chance for it to fail, because it cannot fail. It is bound to succeed; it gets better and stronger, more forceful and more interesting every day to every man connected with the movement, and to every employe on the road who knows about it. When we can say on the North Western that in one year, the year when other roads showed an increase of ten or fifteen per cent in injuries and deaths to their employes, that we showed a decrease of 35 per cent, think of such a thing as that failing! It cannot fail.

Just as soon as the North Western men understood it was they who got hurt and not the officers of the road; that it was they who leave widows and orphans and not the stockholders and directors; when they understood that every time one of them was killed or injured and taken out of service it increased the risk of the rest of them because a green man had to be put in his place, just the minute that that thing got under their belts, the North Western men, who are the best lot of railroad men in the world, took hold of it and made it the success that it has been made. It was the North Western men, it was not the officers; the officers have not done it, they have assisted, but 95 per cent of all the men on the safety committee of the North Western are the men who do the work. Not the bosses—we do not want the bosses on the committee. We want the men because it is they who are getting hurt. The men who are doing the work, and you know and I know and we all know that it is the men on the railroads, not the officers, that run the railroad, and just as soon as we can get them to understand that,—and they are understanding it on the North Western—just so soon will the safety first movement be more successful, be stronger and better than it ever has been before. Today, with an increase in the business on the North Western of 15 to 20 per cent we show a decrease of 10 per cent in accidents over what we had a year ago. That is what the North Western men are doing, and they have learned that they want to get rid of the chance taker, because the chance taker is the man who makes cripples; he is the man who makes widows and orphans; he is the man who supports the undertaker and the doctor and the artificial limb maker, and we are getting rid of him on the North Western.

We do not want discipline by the officers, we are going to have discipline by the men, because our men are coming to realize themselves that these chance takers, these men who do not go out to flag; these men who go in between the moving cars, these men jumping on the pilots, these men who do all these dangerous things that bring about accidents, are the men that endanger their lives and limbs as well as their own, and they are going to discipline them and that is what we want them to do. They are going to take them into their lodges and in their switch shanties and in all places where men congregate and say, "Here, damn you, we are not going to run the risk of getting killed by you." "You have got to observe the rules, or we are going to drive you out." And they will do it; the officers need not do it. That is what we want to do. When a man comes to understand that the greatest risk he runs today is the risk of being injured by some careless or thoughtless man,—and it is more thoughtlessness than it is carelessness—just as soon as we can get our men educated, and we are doing it fast, we are going to put an end to this accident business. And I want to say that all the stigma of this great number of accidents that are occurring in this country have been wrongfully put on the railroads. They do not belong there; they belong in the other industries. Because the government tells us that every year in this country of ours, in carrying on our peaceful industries, 35,000, not 3,500 or 350, but 35,000 workmen are killed every year.

The following statement shows the reduction in accidents on the Chicago & North Western for the twelve months ending June 30, 1912, as compared with twelve months ending June 30, 1910:

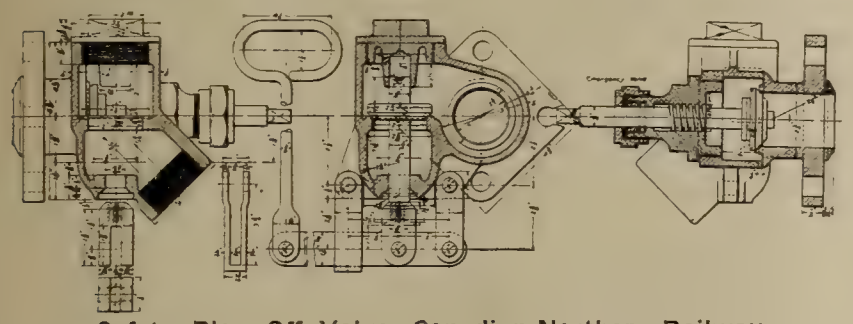
17	fewer	trainmen killed, a decrease of.....	44.7 per cent
1,562	fewer	trainmen injured, a decrease of.....	47. per cent
9	fewer	switchmen killed, a decrease of.....	50. per cent
111	fewer	switchmen injured, a decrease of...	17. per cent
3	fewer	stationmen killed, a decrease of....	50. per cent
134	fewer	stationmen injured, a decrease of..	18.3 per cent
7	fewer	trackmen killed, a decrease of.....	25. per cent
700	fewer	trackmen injured, a decrease of....	40.1 per cent
2	fewer	bridgemen killed, a decrease of.....	66.6 per cent
87	fewer	bridgemen injured, a decrease of...	27.7 per cent

1 less shop and rdh. man killed, a decrease of.	25.	per cent
190 fewer shop & rdh. men injured, a decrease of.	15.	per cent

LOCOMOTIVE BLOW-OFF VALVE.

A blow-off valve which can be repaired, in case of non-seating, without draining the boiler, is in use on the Canadian Northern Ry. The drawing herewith, which is reproduced from the *Canadian Railway and Marine World,* shows the design of the valve.

Essentially, this valve is a double one; one valve being

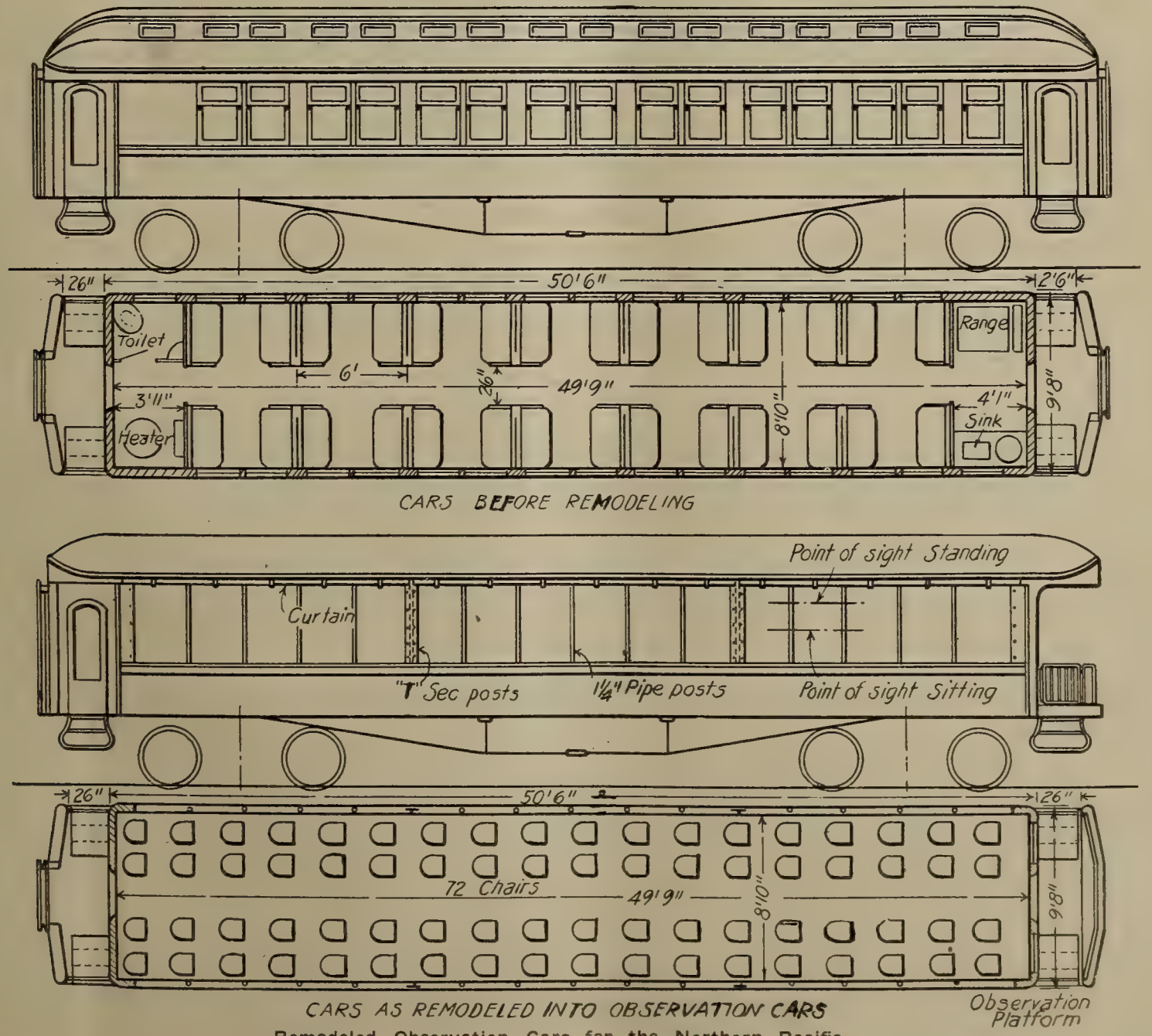


Safety Blow-Off Valve, Canadian Northern Railway.

the blow-off proper and the other an emergency. The blow-off valve itself is on a vertical spindle, and is similar in most particulars to the ordinary blow-off valve, and is operated by a vertical rod from a fulcrumed lever under the valve. Between the blow-off valve and the boiler, concentric with the boiler blow-off hole, there is the other emergency valve, the blow-off valve being offset from it in the same casting. This emergency valve is similar to the blow-off, except that it is operated by a square threaded spindle, at the valve. Normally, this valve is set wide open, with the blow-off controlled by the blow-off valve. In the event of anything going wrong with the latter, the emergency valve can be closed, and the blow-off removed and repaired, without the necessity of draining the boiler. When first applied, the valve was threaded into the side of the water leg, but since then, it has been found advisable to attach the valve by a flange, with a loose ball joint ring between, thereby forming a solid tight joint that will not turn in operation.

NOVEL OBSERVATION CAR.

The mechanical department of the Northern Pacific is now remodeling two cars, for use during the summer season as observation cars on the Livingston-Gardiner line, a branch running from the main line to Yellowstone Park. The cars being remodeled originally had a seating capacity of fifty-six but by removing the toilet and heater compartments, the new seating arrangement will accommodate seventy-two passengers. The sides of the cars have been removed down to a point corresponding to the window sills, the roof being supported on each side by two "T" section posts, while 1¼ inch pipe posts are spaced between at regular intervals. Curtains are provided along the sides, for use in unfavorable weather. The forward end of the car is equipped with the regulation vestibule and at the rear is an observaion platform similar to those in general use. Passengers will be seated in movable chairs and the opening along the side is high enough to allow a free view, whether one is standing or sitting. This arrangement will give patrons of the Great Northern traveling into the National Park an excellent opportunity to view the beauties of nature along the route.



Remodeled Observation Cars for the Northern Pacific.

ELECTRIFICATION OF STEAM RAILWAYS.*

By N. W. Storer.

The belief in the unbounded possibility of electricity has led to the idea that it is only a matter of a few years before all the steam locomotives will be relegated to the scrap heap. I used to share the belief, but the more I learn of the subject, the more respect I have for the steam locomotive and the work it is daily performing, and the greater the task of supplanting it with the electric appears to be; not that we are doubtful as to the ability of the electric locomotive to do the work, for we are certain that almost any railway can handle more traffic and do it better when operated by electricity than by steam. What, then, is the reason for doubting the speedy and general substitution of electricity for steam? Simply that the traffic on most railways at the present time would not pay for the large initial investment necessary for operating it by electricity.

A steam locomotive is an independent power unit requiring supplies only of fuel and water at intervals along the road. The electric locomotive is in itself powerless. It must have a power house back of it, with transmission lines to carry the power to it wherever it may be.

As the electric locomotive itself is much more expensive than the steam engine, and the power house and distribution system cost a great deal more, the investment for operating a heavy railroad by electricity must, therefore, be relatively very large, and unless the frequency of trains is high enough to maintain a good load factor on the line, sub-stations and power house, it can scarcely pay. In other words, electric operation will pay if you can keep the apparatus working a reasonable percentage of the time, but will not pay if the percentage is small. A bank cannot pay interest on deposits when 90 per cent of them are locked up in the safe. Similarly, a man who has a high-priced automobile that is run only 1,000 miles per annum, is paying a very high price per mile; much higher than the man whose machine covers 10,000 miles. Any apparatus must be used in order to make it pay for itself.

In comparing the cost of electric with steam locomotives, one railway official went so far as to say that the electric locomotives used to haul their trains cost not $35,000 each, which was the contract price for them, but $100,000 each, which was the cost of the entire installation, divided by the number of locomotives. This might appear to be the case, but it is not strictly correct, unless the cost of all the roundhouses, machine shops, coal handling and distributing apparatus, water tanks, etc., be included in the cost of the steam locomotives. Even that, however, would leave the cost of the latter motive power only a fraction of that of the electric. Under such a handicap, it cannot be expected that the railroads, which are laboring under great financial difficulties at the present time, will be able to electrify their lines except under conditions that absolutely require it or offer exceptional advantages.

Compulsory conditions are sometimes imposed by legislation to force a railroad to electrify to abate the danger and discomfort of operating steam locomotives through long tunnels. This was the immediate cause of the adoption of electricity as a motive power by the New York Central and the New Haven railroads, for the entrance to New York City. This electrification cost a tremendous amount, but it has resulted in a most magnificent terminal, increased comfort and safety to the traveling public, and last but not least, in increased value of real estate owned by the railroads, which bid fair to make the electrification a paying investment. If this last proves to be really true, it will be most important, as it will make electrification much more attractive to the far-seeing railway officials and will result eventually in the electrification of the terminals in all the large cities.

Beginning with the B. & O. R. R. at Baltimore, in 1895, a number of railroads have electrified tunnels which were a constant menace to the health and lives of the passengers and train crews. The St. Clair tunnel of the Grand Trunk Railway was electrified in 1906, and since then the Detroit river tunnel of the Michigan Central, the Cascade tunnel of the Great Northern, the Hoosac of the Boston & Maine, the Pennsylvania tunnel leading to the great terminal in New York City, have all been electrified in this country and are operating with great success, handling both passenger trains and the heaviest freight trains on both heavy grades and level track. These tunnels, in all of which, except the Pennsylvania, steam engines were originally operated, will be remembered by travelers as the places where every one was formerly nearly stifled. Now, either in the hottest summer day or the coldest of winter weather, the tunnel is welcomed as being the most comfortable part of the ride.

Another phase of the situation that is now receiving a great deal of attention is on the mountain grades where the heavy freight trains crawl up at from 5 to 10 miles per hour, and the passenger trains crawl up at from 10 to 20 miles per hour. These grades always form the "neck of the bottle," and limit the amount of traffic that can be handled by an entire road. Even if it cost a great deal more to operate such grades by electricity, it would pay large dividends on the investment by increasing the capacity of the entire road.

Someone may wish to inquire how this electrification will increase the capacity of the entire road. It is effected by increasing the speed both on the up grade and the down grade, and by the greater reliability of service. On electrified divisions, the heaviest freight trains of 2,000 to 3,000 tons trailing load can readily be hauled up a grade of 2 per cent by electric locomotives at speeds of 15 to 20 miles per hour, while the speed with steam locomotives would be usually from 5 to 8 miles per hour. This is possible because the electric locomotive has the power house back of it, but does not have to haul it up the hill. At speeds of 15 to 20 miles per hour it will have all the weight on drivers, and usually only as much as is necessary for adhesion. This being the case it can haul the trains at 20 miles per hour just as efficiently as at 10 miles per hour.

The steam engine, on the other hand, must haul its entire power plant up with it, and consequently the higher the speed at which it operates up a grade, the less load it can pull, so that the economical speed is very soon reached. This appears to be 10 miles per hour, or less, for a 2 per cent grade with heavy freight trains.

As the electric locomotive can take a train up a heavy grade much faster on account of its greater power, so it can take a train down the grade at a much higher speed because the motors can hold the train from accelerating by regenerating power and putting it back into the line to help some other train up the grade, or by using it up in a resistance on the locomotive. This saves the brake shoes for use in stopping the train only and thereby eliminates a great deal of the danger of taking trains down grades. Incidentally, the saving in power may be as much as 25 per cent, and the saving in brake shoes and general wear and tear of the equipment will also amount to a considerable item.

We, therefore, have the greatest confidence in inviting the attention of railroad officials to the electrification of their mountain grades, for if the traffic is at all congested there, electrification is bound not only to improve the service, but to give a very substantial return on the investment. The electrification work that has already been done is enough to show that electric locomotives can handle any kind of service from the heaviest slow-speed freight service to the fastest of heavy passenger work.

The next question is, when will the great lengths of line between the terminals, and connecting terminals and grades, be electrified? That is something that will depend entirely upon the territory through which the road passes and the population of the terminals. I regard it as entirely possible, if not highly probable, that within the next ten years one can travel from Boston to Washington by fast trains over the New York, New

*Before the Cleveland Engineering Society.

Haven & Hartford and the Pennsylvania railroads, behind electric locomotives. The New Haven is now operating all trains between New York and Stamford by electricity and is rapidly extending its electrification to New Haven. It is also working at the Boston end of the line between Boston and Providence, besides having its Harlem river division and its immense freight classification yards operated exclusively by electricity.

The Pennsylvania has the vast network of lines on Long Island, besides the New York terminal, operated by electricity. It is now working on the Philadelphia terminal which must be electrified in order to increase its capacity. The bad tunnel at Baltimore must be electrified and the terminal at Washington must soon follow. With these city terminals all electrified, it is a foregone conclusion that the whole distance from New York to Washington will be equipped, as it would be impractical to have any breaks in the service; aside from this consideration, however, I believe that the population is so large as to make it a paying investment anyway.

Similar results will follow in other sections of the country, but more slowly and only as it is found by the railroads to pay a good return on the investment. That is the only thing that will make general electrification possible. No matter how desirable it would be to the public, the railroads cannot electrify until it can be made to pay, either at present rates for freight and passenger service or by the undesirable alternative of higher rates for the improved service.

Just a word to people who are for compelling the railroads to electrify their terminals in large cities. Don't do it. The railroads in this country are fully alive to the advantages of the electrification for such situations; or if not now, they soon will be, for they are all studying the subject with the greatest care. I believe the matter can be safely left in their hands for a few years, at least, until the necessary plans can be made and all the innumerable details connected with the adoption of the new motive power are fully worked out. Without this careful consideration, the plans will be only half baked, and vast sums of money will be wasted and the full advantages of electrification will not be secured. When the railways of any city decide to electrify the terminals, they should work out a harmonious plan that will include all of them, so that power may be furnished from a common power house, and all equipment be interchangeable.

Electrification is bound to come on a large part of the railroads sooner or later in any case, but the steam railways should not be forced into it until they have had ample time to mature their plans.

There are many, many advantages from it, some of which are only beginning to be understood and some of which have never had the correct value. When all have been shown by experience to have certain definite values, and the best way to secure the advantages has been thoroughly worked out, the railroads will need no compulsion.

Types of Electric Locomotives.

The different forms of transmission between motors and driving wheels in different types of locomotives are distributed as follows:

1st. Gearing motors directly to the axles as on the ordinary street car. Among the locomotives of this type are one experimental locomotive for the Pennsylvania railroad, the St. Clair tunnel and the Spokane & Inland, all being suitable for service at speeds below 30 miles per hour. Operating with this type of locomotive with heavy motors mounted directly on the axle is confined to low speeds because of the effect upon the track on account of the dead weight on the axle and the low center of gravity.

2nd. The locomotive having the motors mounted on a hollow shaft surrounding the axle; these hollow shafts or quills being connected to the wheels through the springs. The early New Haven passenger locomotives were of this type and have been quite successful, although some trouble was experienced with them after a few months of operation, on account of nosing. This was overcome by the addition of pony wheels at each end of the locomotive and the use of a toothed cam centering device. This type of locomotive is very successful as long as the track is kept in good surface, for, in spite of the low center of gravity, the motors are entirely spring borne, so that a direct shock is very seldom given to the track.

3rd. The third type of locomotive has the motors geared to the quill surrounding the axle, which is connected to the driving wheels through long, flexible springs which permit the motor and quill to move a total distance of three inches in a vertical direction with respect to the axle. It is, therefore, possible to mount the motors directly on the truck frame. This form of locomotive is made for the New York, New Haven & Hartford, with both one motor per axle and with twin motors. Where one large motor is used, it is necessary to have double gears which require very accurate alignment. Where twin motors are used, only one gear is required and both of the motors drive through the same gear. The small motors are found to be less expensive for single phase work and are lighter and easier to handle. On the New Haven railroad, the same motors are used for both locomotives and multiple unit cars, excepting, of course, the motor frames which have to be adapted for a different type of mounting. This type of locomotive gives high center of gravity and is an exceptionally easy riding machine. All of the weight above the wheels and axles is spring borne, and there being absolutely no tendency for nosing, the machine is very easy on the track and is very comfortable to ride in. Locomotives for both heavy freight and passenger work and for switching service with this type of drive are operating. The type has been adopted as a standard by the New York, New Haven & Hartford, which has purchased over sixty locomotives of this type.

4th. Locomotives with motors mounted high in the cab and connected to the driving wheels through parallel rods from the motor to a jack shaft on the same level as the driving axles and thence to the drive-wheels by other parallel rods. The principal locomotive of this type which has been built is that of the Pennsylvania for use in the New York terminal. This is probably the most powerful electric locomotive ever built. It is used to haul trains of more than 800 tons weight up a 2 per cent grade into the station. The locomotive weighs about 160 tons and has exerted a drawbar pull on level track of nearly 80,000 pounds. It is also able to handle the heavy passenger trains at 60 miles per hour on level track. This type of locomotive has the highest center of gravity of any that have been built, and its operation on the track is similar to that of the best steam locomotives. A few years ago this would not have been considered very good by electrical engineers, but sad experience with machines having low center of gravity has modified their opinions to a great extent and they are now glad to claim that such locomotives are as good as the best steam locomotives. This locomotive has established a wonderful record for reliability, there being only thirteen train minutes delay charged against the locomotives in the first year's operation. Such a record with 33 locomotives is little short of marvelous.

Another type of locomotive is that of the Italian State railways, which connects the motors to the driving axles through a Scotch yoke. This is a form of side rod which is quite satisfactory for slow and moderate speed service. It has never been used for high speeds.

Still another type is a combination of gears and side rods. This form is used for the locomotive built by the Oerlikon Company, in Switzerland, for the Loetchberg tunnel. The motors are geared to a jack shaft, instead of connecting to the latter by means of parallel rods as in the case of the Pennsylvania locomotives. This permits the use of a much higher speed motor and a considerable reduction in the weight and cost of the locomotive. It also enables the use of a single design

of motor for various speeds of locomotives which may be secured by simply changing the gear reduction.

Electrical Systems.

It is generally recognized among the electrical fraternity at the present time that there has been entirely too much discussion about the system used for electrification. The fact is that there are several systems now in successful use. The three-phase locomotives in Italy, which have a constant speed characteristic, are giving excellent results on the Italian State Railways. The State Railways of Germany and Switzerland are committed to the single-phase system. They use 15,000-volt, 15-cycle, single-phase alternating current on an overhead wire. In France they are electrifying the Midi Railway with single-phase current at 16⅔ cycles. They are also doing some terminal electrification with direct current. In England there is some single-phase work and some direct current; the latter at 600 volts. In this country we have at present in use direct current at 600, 1,200 and 1,500 volts, with several lines projected at 2,400 volts. There is single phase in use at 2,200, 3,300, 6,600 and 11,000 volts. It is, of course, understood that with single-phase system, the overhead voltage can be anything that is desired within the bounds of reason, and practically the only change in the equipment necessary is in the transformer on the car or locomotive, while with direct current a more extensive change is necessary. The New York, New Haven & Hartford Railroad has the most extensive electrification under way at the present time. This is with the single-phase system. As a matter of fact, railways can be electrified successfully with any of these systems and all have been pretty well tried out in service with the exception of the 2,400-volt direct current. It will be eventually decided on the basis of cost. There is not enough data at hand to settle this at the present time.

The original New Haven construction was heavy, inflexible and expensive. It has been modified so that the operation is entirely successful. The new construction has been designed with all of the experience gained from the original construction. Its cost is less than half that of the original and it is a better and safer construction. It is well protected from lightning by the grounded steel catenaries which support the entire overhead construction. It is probable that this later construction will be still further simplified. I have no doubt that it will be much simpler and cheaper before the final solution is reached.

In this country, there is no overhead construction for high voltages that compares in cheapness with that in Italy and Germany. The construction there is extremely light and much cheaper than our own.

CORRESPONDENCE SCHOOL OF RAILWAY ELECTRICAL ENGINEERING, PENNA. R. R.

A free course of correspondence study in electrical engineering and associated subjects has been inaugurated by the Pennsylvania Railroad under the supervision of J. C. Johnson, superintendent of telegraph.

The course of study will consist of a series of instruction papers in pamphlet form, each covering a different field and including elementary work on direct-current, and alternating-current circuit and apparatus; mathematics, mechanical and geometrical drawing; magnetism and its application to electric generators, motors, measuring instruments, telegraph, telephone, signal, lighting, traction and general electrical equipment; every-day troubles developing in each type of apparatus, and methods of locating and correcting them.

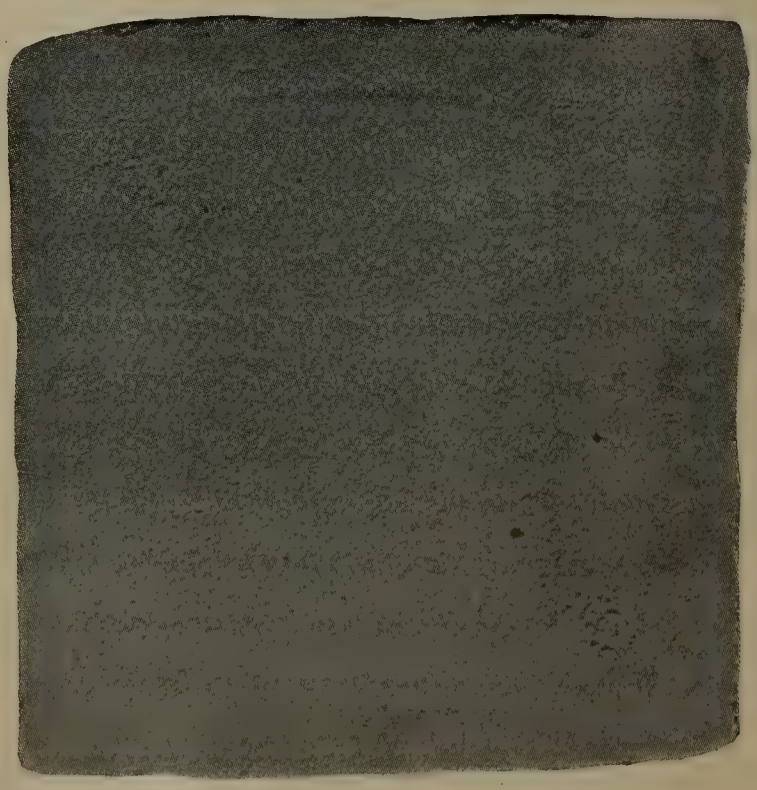
Besides providing a means for the education of its employees in existing applications of electricity, it is understood that the company has adopted this method to train the largest possible number of its men for the duties that will devolve upon them when electric traction is substituted for steam locomotive haulage. Students are invited to ask questions, and a course of supplementary reading of text-books and periodicals is recommended.

The first textbook in the educational course is elementary arithmetic, followed by pamphlets on primary cells and direct current. Fourteen of these pamphlets, concluding with electric traction and power plant design and apparatus, will complete the course.

FORGING PRESS WORK.

An argument for the use of forging presses for some shop operations now done on the steam hammers, was contained in an editorial in the February issue of the *Railway Master Mechanic*.

Top or Piped End of Ingot Forged Under 500-Ton High-Speed Press.



Bottom End of Ingot Forged Under a 6,000-Pound Hammer.

The illustrations herewith depict the difference between the works of a press and a steam hammer on two ends of the same ingot. The sections were not obtained until the works on both ends had been completed. Examination will show that the press has worked the grain of the ingot much more uniformly and clear to the center.

It is believed that the trial was fair to both hammer and press and that there was no advantage given either. The horizontal creases noted in the illustrations are due to folded photographs.

Locomotive Laboratory, University of Illinois*

By Edward C. Schmidt.

Professor of Railway Engineering, University of Illinois.

An accurate knowledge of locomotive performance is as necessary to the railway operating officer and to the locating engineer as to the locomotive designer, and in periods of rapid progress in locomotive development the need of such knowledge becomes the more urgent. To satisfy this need there has been continually put forth, even in the earliest days of the locomotive's career, much well directed and fruitful effort which has contributed no small share to its improvement. In the beginning, such effort had for its chief purpose the improvement of the mechanical features of locomotive design rather than improvement in its economical performance; but in later years, under the demand for decreased operating costs, this effort has been directed chiefly toward developing accurate information about the performance of the locomotive boiler and engines and of the machine as a whole.

Of course much important information concerning performance is embodied in the ordinary statistics of operation which are available to every railway officer. Changes in locomotive design which effect radical changes in performance show themselves unmistakably in such statistics. Changes in performance less radical but nevertheless important are however frequently so disguised in such statistics as to baffle even the best informed. As a source of data concerning locomotive performance, ordinary operating statistics are at best difficult to interpret and, had we been compelled to rely upon them solely, our knowledge of performance would be very meager indeed.

Until about twenty years ago the only other source of accurate and specific information concerning locomotive performance was the data derived from specially arranged road tests. Such road tests were conducted as early as 1835-1840 and they have ever since been a fruitful source of important knowledge. For certain purposes they will never be displaced. Anyone who has conducted such tests is well aware of their difficulty and expense. Every measurement connected with the determination on the road of boiler and engine performance

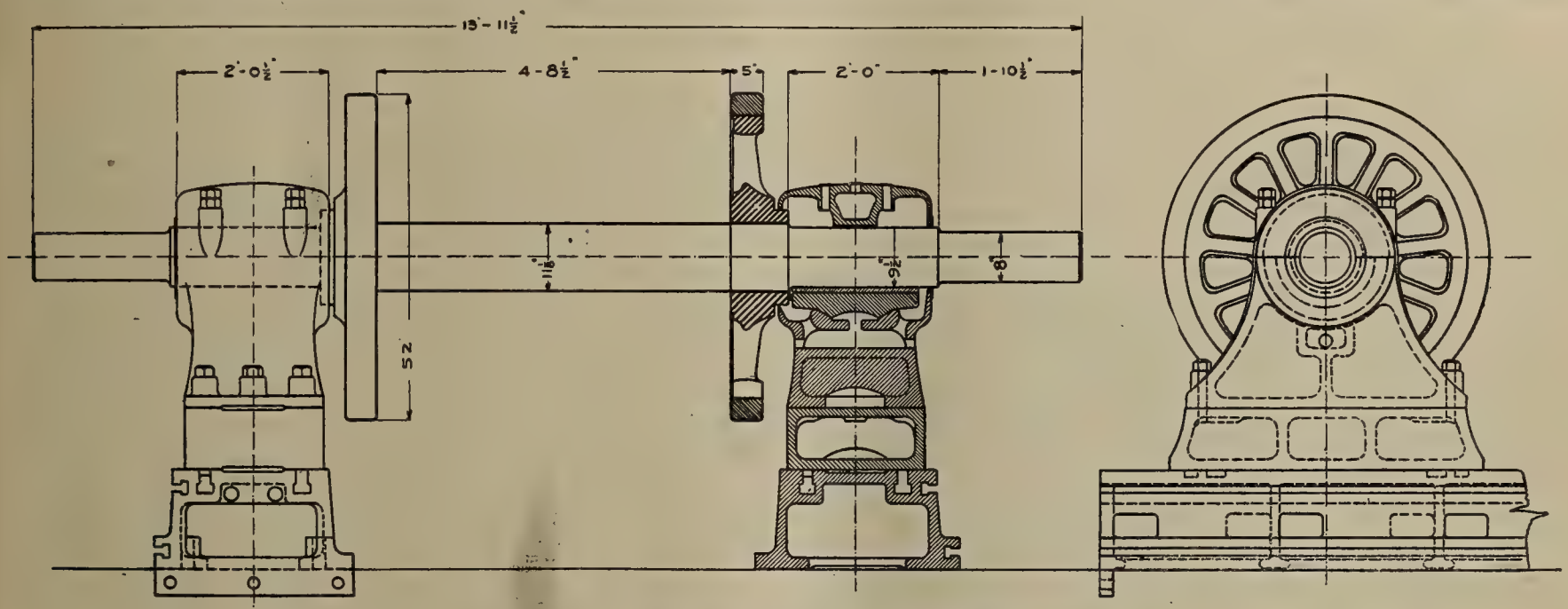


Fig. 1—One Pair of Supporting Wheels With Axle Bearings and Plate.

*From a paper before the Western Railway Club.

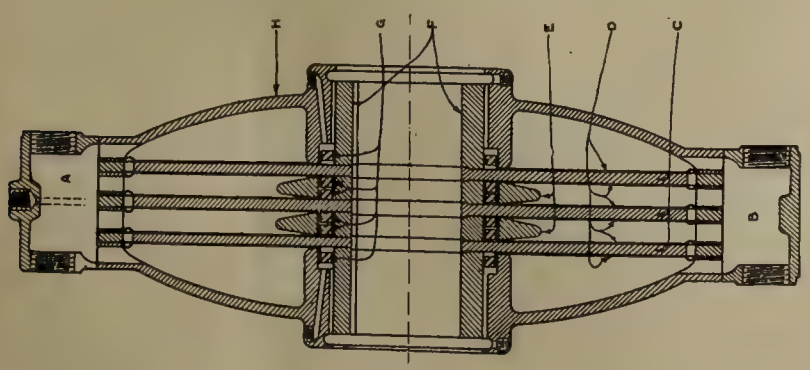


Fig. 2—Cross Section of One of the Brakes. Mounted on the Ends of the Supporting Axles, These Brakes Absorb the Power Developed by the Locomotive.

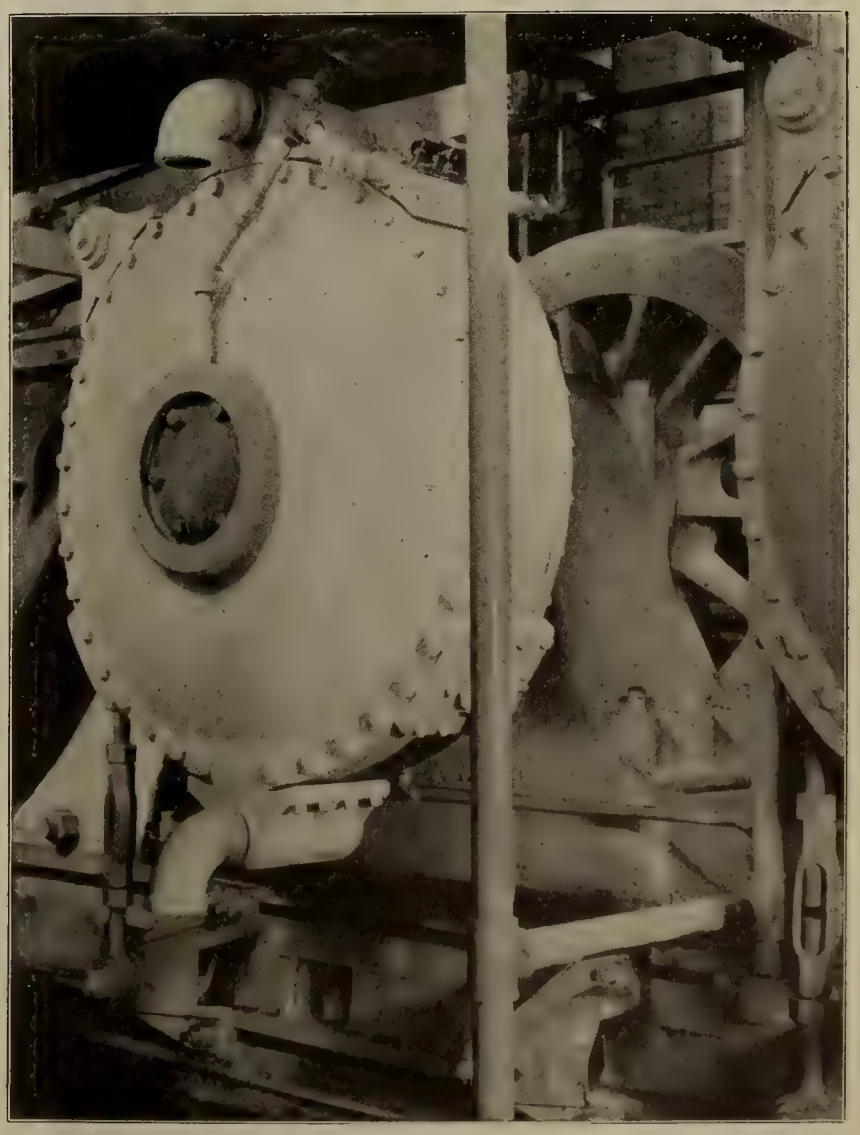


Fig. 3—An Interior View of One of the Brakes—The Water Piping and Oil Piping Are Removed—This View Shows Also One of the Bearings and a Supporting Wheel.

of the locomotive is much more difficult than in the stationary plant. The measurement of coal and water and the taking of indicator cards, for example, are very difficult operations under the conditions of road service, and operations whose accuracy can be assured only by great effort and skill. Nevertheless when the importance of the purpose warrants the expense, the difficulty of making road tests would be willingly incurred if their usefulness were not otherwise limited. It is however greatly limited by the fact that on the road many of the conditions of operation are entirely beyond control; and consequently even the most skillfully and conscientiously conducted road tests sometimes fail to produce conclusive evidence. In comparing two locomotives of similar design by means of road tests, small differences in their performance are frequently overbalanced by differences in the conditions surrounding the tests which are entirely unavoidable. For such reasons it is practically impossible, for example, to satisfactorily

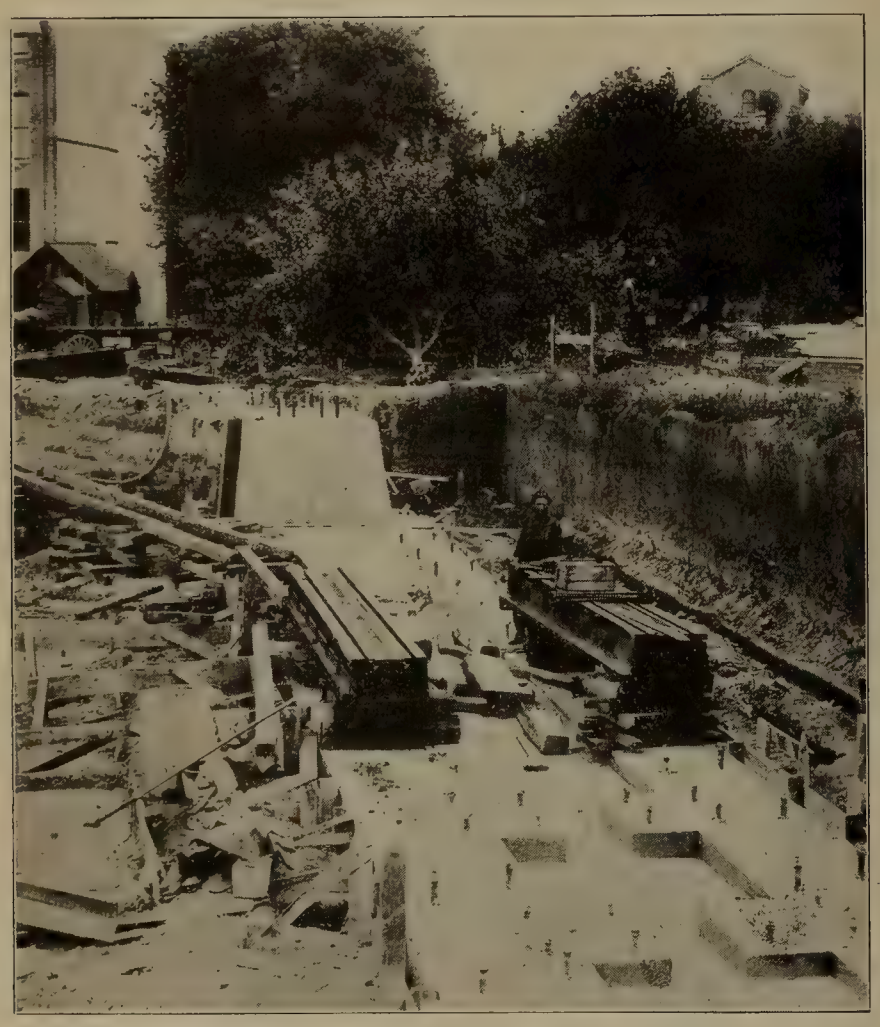


Fig. 4—Foundation for the Supporting Mechanism and for the Dynamometer—This Foundation Is of Reinforced Concrete—Two of the Bed Plate Sections Are Being Put in Place.

determine by road tests, the difference in the economy of using two similar kinds of coal, or to determine the effect upon steam consumption of changes in valve gear design. The limitations and disadvantages of road tests are not thus emphasized through any lack of appreciation of the extent of their contribution to the art of locomotive engineering, but to make clear their inherent inadaptability to some purposes. On the other hand, they offer the means of settling certain questions which cannot easily be treated in a locomotive testing plant and for such purposes they will not be displaced.

The locomotive testing plant fortunately has placed at our disposal a means for studying the locomotive which has made good the deficiencies of road testing. The first locomotive testing plant was built twenty-one years ago at Purdue University. It was designed by Dr. W. F. M. Goss, who was at that time in charge of the schools of engineering at that institution. Everyone interested in locomotive engineering knows of the epoch making record of that plant and is familiar with the voluminous and illuminating information developed there by Dr. Goss during his connection with Purdue University and in later years by Dean C. H. Benjamin and Professor L. E. Endsley. The work of this laboratory, during its twenty years of operation has continually given us original and timely information concerning all phases of locomotive performance, which has had a most significant influence on locomotive design both in this country and abroad, and which will always stand to the great credit of those responsible for that inception and activity of this laboratory. Not the least of the good influences of this plant is the encouragement which its success has offered to other experimenters to establish similar laboratories. At present there are four such testing plants in this country and two in Europe. The Purdue plant, erected in 1891, was followed in 1894 by a temporary plant, at South Kaukauna, Wisconsin, on the Chicago & North-Western Railway, designed under the direction of Robert Quayle. This was succeeded in 1895 by a permanent plant, designed by Mr. Quayle and erected at the C. & N. W. shops in Chicago. In 1899 Columbia University, having been given an Atlantic type locomotive by the Baldwin Locomotive Works, provided for it a testing plant which is erected in their mechanical engineering laboratory. In 1904 the Pennsylvania Railroad installed at the Louisiana Purchase Exposition at St. Louis, what was at that time the largest and most elaborate plant yet built. This was removed after the Exposition to Altoona, Pa., where it has since been in almost constant operation. In 1904 there was also erected in the Putiloff Works at St. Petersburg, Russia, a similar plant designed by Messrs. M. V. Goloboloff and S. T. Smirnoff. The following year there was erected in England another plant under the direction of G. J. Churchard of the Great Western Railroad, at the Swindon Works of that company.

The justification for the existence of locomotive testing plants lies in the fact that in them only can the locomotive be run under conditions which may be rigidly controlled and varied at will. It is also true that in the test plant the difficulty and expense of making tests are both greatly reduced; but this in itself is less important than the control of the operating conditions which test plant service puts in the hand of the experimenter. In the laboratory, the load and speed may be held uniform throughout any period of time or they may be made to vary according to any predetermined program. Variations of wind velocity and air temperature are eliminated. All the advantages which laboratory tests have over road tests lie in this power to control conditions. As a consequence of this control practically all questions relating to boiler performance can be better and more easily settled in the testing plant than on the road and the same remark is equally true of questions touching engine performance. There are but few problems relating to fuels which cannot be more easily attacked and more conclusively settled in the testing plant than on the road; and certain problems—like the determination of engine friction—which lie beyond the reach of the experimentor who must rely on road tests, can be successfully attacked in the locomotive laboratory. Supplemented occasionally by road tests made by means of a dynamometer car, the locomotive testing plant makes possible a knowledge of locomotive performance as exact as that which is available concerning the stationary steam engine, the turbine, and the gas engine. Locomotive laboratories have had and will continue to have an important influence on the development of the locomotive. An addition to the small number of existing laboratories is therefore an event of interest to all railway officers, and it has seemed appropriate to present a description of the new plant which has been recently erected at the University of Illinois and which will be first put in operation next month.

At its last session, the Legislature of the State of Illinois included among its appropriations for the University of Illinois the sum of $200,000 to be used for new buildings for the

College of Engineering. The president and the trustees of the University after weighing the claims and needs of the other engineering departments decided to use this fund in erecting a transportation building and a locomotive laboratory for the department of railway engineering.

Any locomotive laboratory consists essentially of, first, a means for so supporting the locomotive that its wheels may be rotated and that the power developed may be absorbed and either dissipated or transferred; second, a means for anchoring the locomotive when so mounted and for measuring the tractive effort developed; third, means for supplying and measuring coal and water; and finally, means for disposing of the gases and steam from the front end. The supporting mechanism consists in this plant, as in all others, of wheels whose position may be varied to conform to the spacing of the locomotive's driving wheels. In this case the supporting wheels are 52" in diameter, provided with plain tires and mounted on 11⅛ inch axles. The axles and tires are of the highest grade of heat-treated carbon steel and were furnished by the Midvale Steel Company. The use of 52" supporting wheels involves rotating speeds as high as 500 revolutions per minute in testing high speed locomotives. Such speeds may give rise to difficulty in the operation of the bearings although they have been designed with regard thereto. In anticipation of such difficulty however, provision has been made in the design of the bearing pedestal for using 72" diameter supporting wheels, if it later proves desirable to do so. The axles are supported at each end just beyond the wheels, in bearings 9½"x20" which are provided on the under side of the journal only. These bearings are carried in self aligning shells which are supported in pedestals of exceedingly heavy construction. Oil is provided at two points in the bearing cap, where it is supplied under the head from an elevated supply tank. The bearing pedestals rest on massive cast iron bed plates which run the entire length of the testing pit, and are secured thereto by the bolts whose heads are held in slots running the length of the bed. The pedestals may therefore be shifted to any desired position on the bed. The general design of the axle, wheels, bearings and bed plate is well represented in Figure 1. Each of these units, consisting of an axle, two wheels, and two bearings constitutes the supporting element for one pair of locomotive drivers. So supported, the driving wheels may turn; and there remains to be provided a means for absorbing the power developed at the driving wheel rim.

The brakes shown in figures 2 and 3 furnish this means. They are of the type used in all other American testing plants,

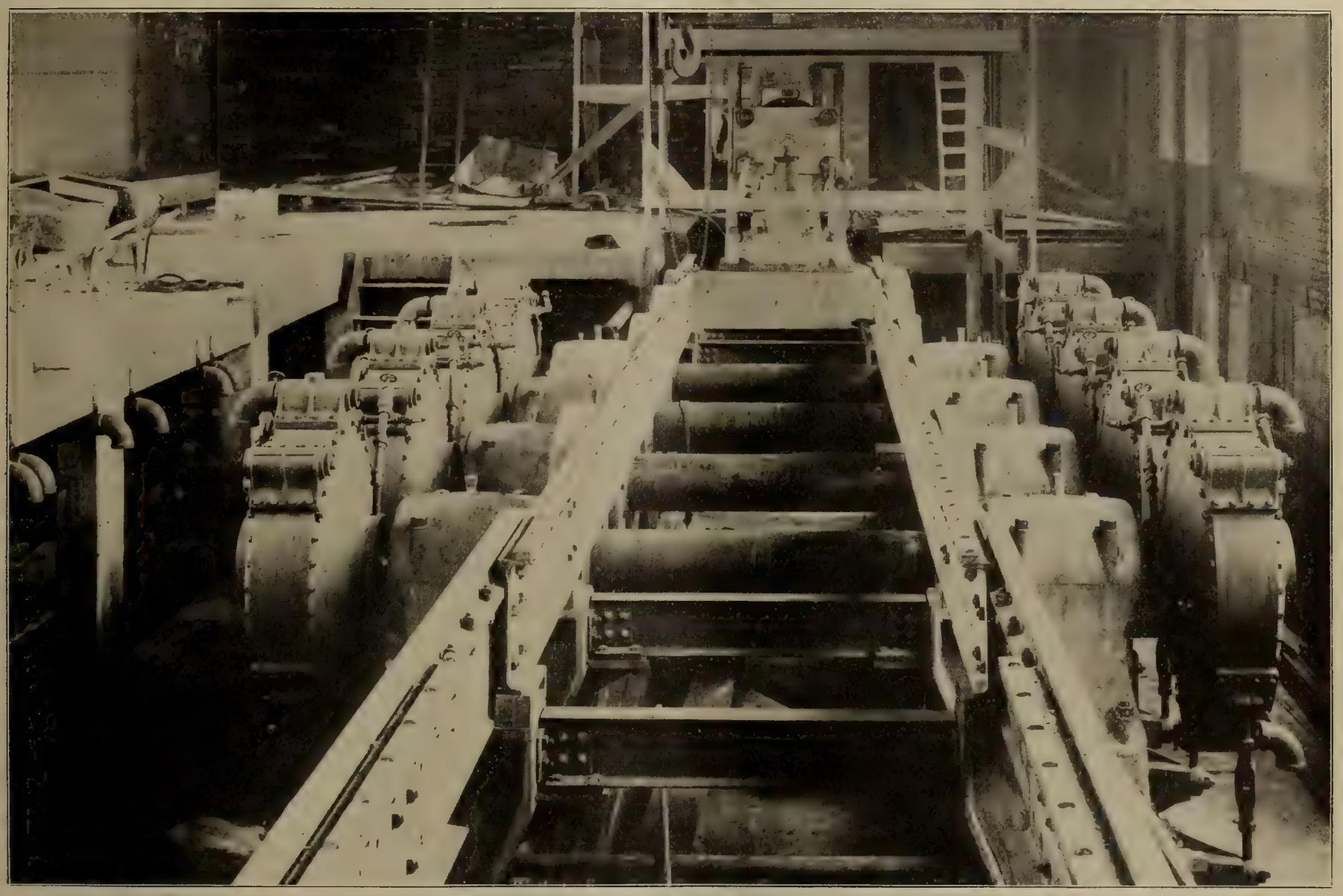


Fig. 5—The Rear End of the Testing Pit, Showing the Removable Track, the Supporting Wheels, the Bearings and the Brakes in Position for Testing a Consolidation Locomotive.

and were designed and furnished by Professor G. I. Alden of Worcester, Mass., under general specifications prepared by the designer of the plant. One of these brakes is mounted on each end of each supporting axle. Each brake consists essentially of three cast iron discs (C) which are keyed to the supporting axle, and which rotate between water cooled copper diaphragms (D) carried in a stationary casing (H). The cast hub F and the three discs form an integral rotating element which is keyed to the axle and turns with it. The casing and its diaphragms are prevented from rotating by means of links attached to the bed plates which appear in Figure 3. The diaphragms provide within the casing three compartments within which the cast iron discs rotate. The surfaces of the discs and of the diaphragms are lubricated by oil fed in at the periphery of the discs and taken off at the hub. The diaphragms form also within the casing four water compartments which have no communication whatever

with the compartments within which the discs rotate. Water is fed into these water compartments at B and is taken off at A. The pressure existing in these water spaces may be varied at will by means of suitable valves in the brake piping. The operation of the brakes is as follows: Power received from the driving wheels of the locomtive is transmitted through the supporting wheels and axle to the cast iron brake discs; these in turn transmit it by friction to the surfaces of the copper diaphragms against which they rub. By varying the water pressure, the friction between the discs and the diaphragms may be varied in accordance with the amount of power to be absorbed. The entire power of the locomotive is thus dissipated at the surface of the diaphragms and carried away as heat in the water which circulates through the brakes. Each brake is designed to develop a resisting torque of 18,000 pounds-feet which is more than is likely to be transmitted to it by the most heavily loaded locomotive driver. The exterior appearance of these brakes is shown in Figure 3, which shows also a bearing and one of the supporting wheels.

The machinery thus far described, which serves only to support the locomotive and to absorb its power, is all carried

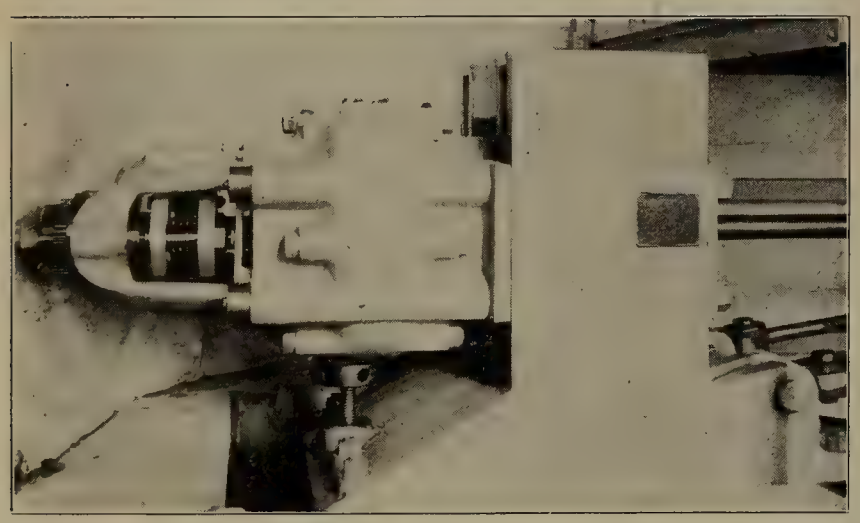


Fig. 6—The Weighing Head and Housing of the Dynamometer.

on a foundation located at the basement level of the building. The foundation is shown in Figure 4, which is a reproduction of a photograph taken before construction on any other part of the laboratory was commenced. This foundation is a slab of reinforced concrete 93 ft. long and 12 ft. wide, varying in thickness from 3½ ft. at the front to 5 feet at the rear. It is surmounted at the rear end by a pyramidal base which serves as the anchorage for the dynamometer. The mounting machinery thus far described is shown in Figure 5 arranged

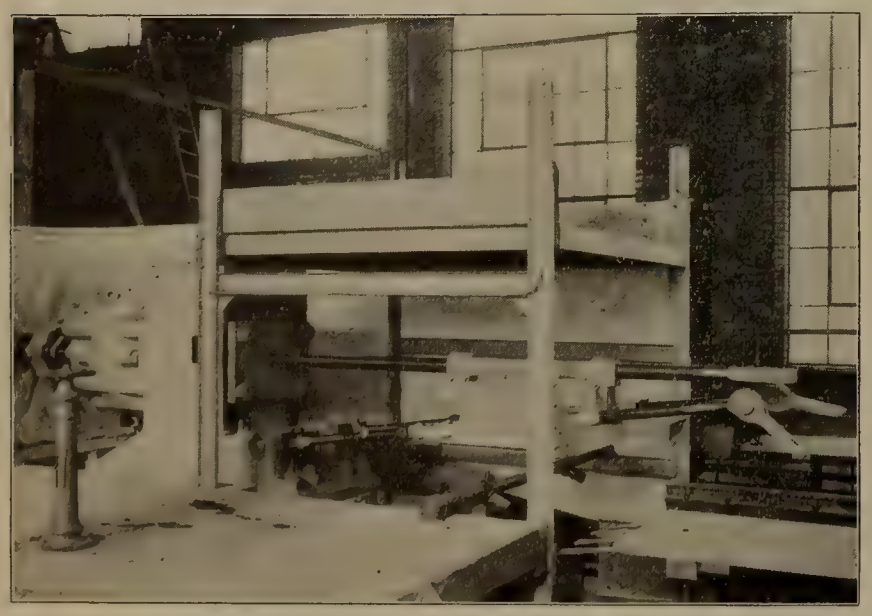


Fig. 7—Dynamometer and Drawbar—The Two Outside Connections Are Safety Attachments—The Firing Platform Appears at the Right in Front of the Dynamometer.

for the reception of a consolidation locomotive. The highest point of the supporting wheels is at the level of the main floor of the building, which is the same as the rail level of the exterior track. The locomotive to be tested is backed into the laboratory over the track shown in position in this view, the tender having been removed. Over the last section of track the drivers run on their flanges leaving the treads free to engage the supporting wheels. When the drivers are properly placed and the locomotive securely anchored this track section is removed. Thus mounted, the locomotive is anchored, by means of a massive drawbar, to the dynamometer, which appears in the middle background of Figure 6. It is thereby prevented from moving either forward or backward from its proper position on the supporting wheels.

This dynamometer, whose chief function is to permit the tractive effort of the locomotive to be measured, is shown in Figures 6 and 7. It is of the well known Emery type designed and built by the William Sellers Company of Philadelphia. While its principles of operation are simple its design is

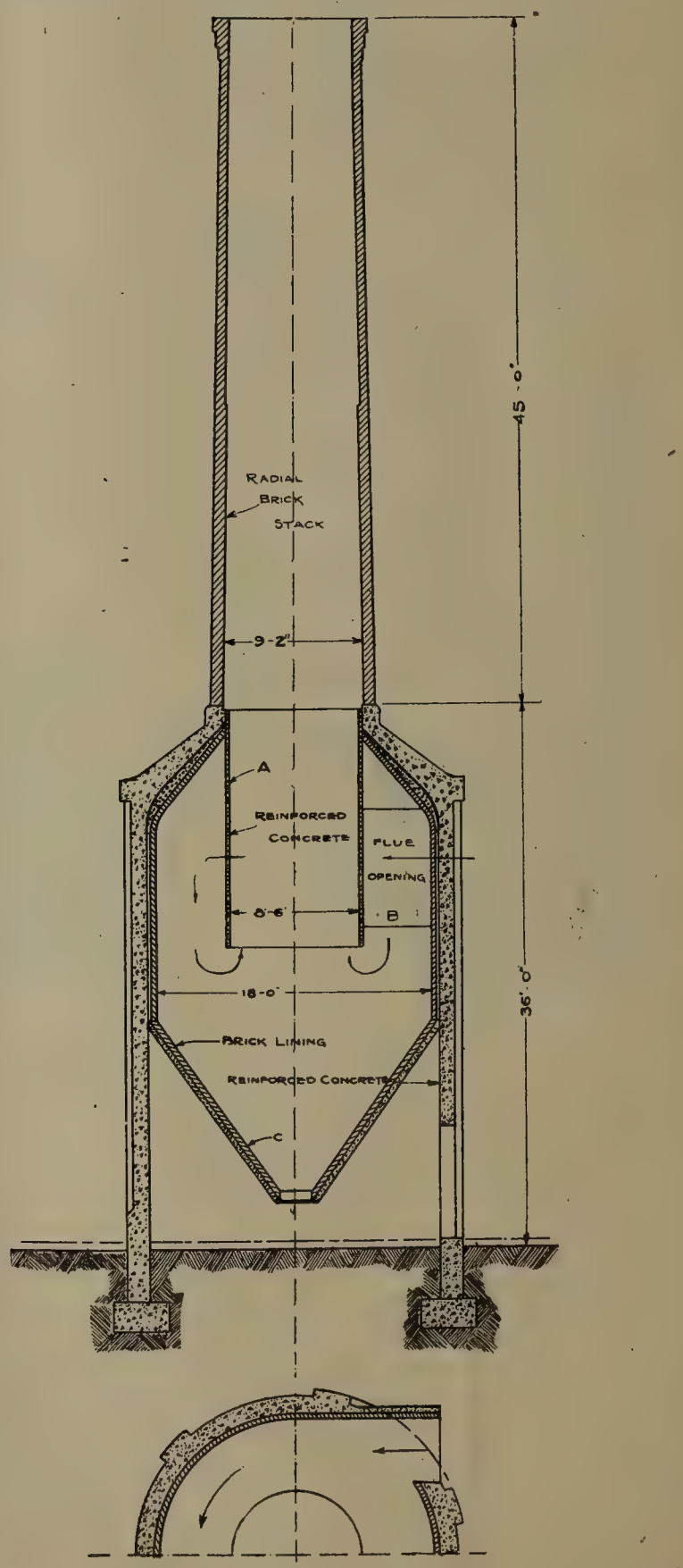


Fig. 8—A Cross Section Through the Cinder Collector and Stack.

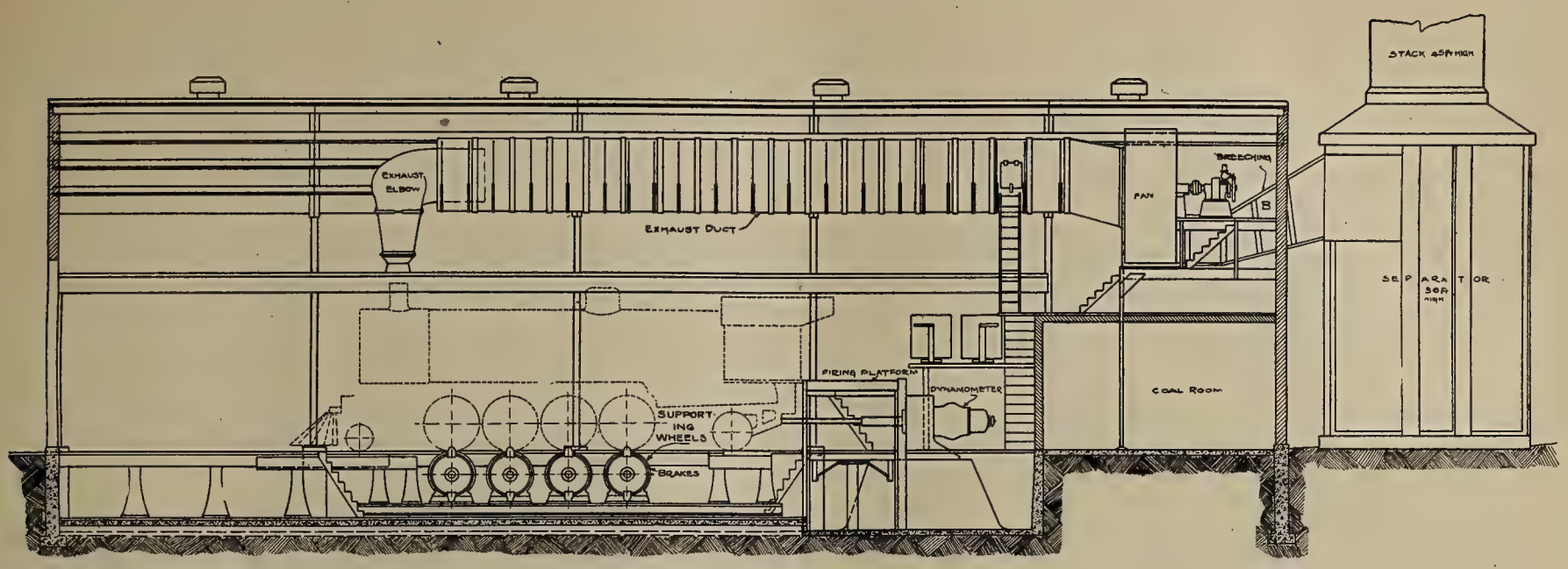


Fig. 9—A Sectional View of the Laboratory.

complicated, and a detailed description lies beyond the scope of this paper. It will suffice to say that it consists essentially of the "weighing head" shown at the left in Figure 6, carried on the housing there shown, and of a weighing scale not included in the picture. Within this weighing head is an enclosed oil chamber with a flexible wall, which receives and balances any force transmitted from the locomotive. The pressure of the oil in this chamber varies with the load and is transmitted through a copper tube of small bore to a similar smaller oil chamber, the pressure within which moves the beam of a substantial but very sensitive scale. The force transmitted to the dynamometer is thus weighed. In design this instrument is very similar to that of the original dynamometer furnished for the Purdue University Plant by the same builders. Its capacity however is about four times as great, namely 125,000 lbs. Up to this limit it will measure with great accuracy any force transmitted to it from the locomotive. One feature of especial interest in the design of the scale lies in the fact that the adjustment of the poise weight on the scale beam is accomplished automatically. This has permitted for the first time in this type of instrument the development of a device whereby the amount of the force weighed on the scale is autographically recorded. The capacity of this instrument is about 15,000 lbs. in excess of the greatest tractive effort which could be imposed upon it by even the most powerful Mallet locomotive now in existence. In this connection it may be remarked that the plant has been designed throughout so that it can receive for test the largest existing locomotives even of the Mallet type; and at the same time all the equipment and the building itself have, in size and capacity, sufficient margin to allow for a very considerable increase in the size, and weight, and power of locomotives before a point is reached when new designs will exceed the capacity of the plant.

It would unduly lengthen this description to describe in detail such minor features of the plant as the means for weighing and supplying the water to the boiler and brakes, and for storing and weighing the coal. These and all other details of the plant have received the most careful consideration in order to insure their accuracy, convenience, and durability. They include the weighing tanks, hydraulic elevator, scales, coal room, and firing platform whose general design and arrangement is shown in Figures 9 to 11. The water supply perhaps warrants further mention. The general water supply of the University is from driven wells, the demand upon which approaches at times their full capacity. No other source of cooling water for the brakes is available. Water from the brakes could not therefore be wasted, and provision has been made for cooling and recirculating it. For this purpose there will be built in the ground outside the building a reinforced concrete reservoir of 100,000 gallons capacity. A supply pump for the brakes draws water from this reservoir, pumps it through control valves to the brakes, whence it returns through another set of control valves to a pump located in the basement of the laboratory. Another pump returns it from here to the reservoir. The feed water is drawn from this reservoir by a separate pump, passed to the weighing tanks and feed tank and thence to the injectors. This feed water, of course, is wasted and must be restored to the reservoir between tests by drawing on the general university supply.

Those elements of the equipment which have been thus far described are similar to the corresponding elements in other locomotive laboratories although they differ from them in the deails of their design and exceed them in size and capacity. In the design of the means for disposing of the exhaust gases, however, new problems were presented and new solutions have been reached. In view of the importance of determining accurately the total fuel lost in the exhaust gases, it was early decided to try to incorporate in the design of this plant some means for entrapping all of the solid matter contained in the gases passing the locomotive front end. This purpose has previously been served by collecting in a sampling tube the solid matter which passes a small section of the exhaust gas stream, and pro-rating the loss of solid fuel thus determined over the entire stream section. This method is not always convenient, and under certain conditions its results are open to some doubt. The preliminary design of a spark trap or cinder collector which would pass the total volume of gas and exhaust steam from the largest modern locomotive when working at high power, made it clear that such a collector would be too large to be located conveniently within the building. A second fundamental consideration in designing the exhaust system was the necessity of providing a stack of sufficient height to insure that the exhaust gases would be discharged high enough above ground to prove inoffensive to occupants of neighboring residences and university buildings. It was decided that this would require a stack about eight feet in diameter and at least eighty feet high. Further study made it apparent that these two decisions could be embodied in one structure combining the cinder separator and the stack. This has been accomplished in the construction represented in cross section in Figure 8, which is located outside of and at the rear of the laboratory. The system will be most easily understood in following (by reference to Figure 9) the course of the exhaust gases as they emerge from the locomotive stack. They are dicharged thence into a steel exhaust elbow which carries the gases up and over to the center of the building, where they are received in a horizontal duct running through the center of the roof trusses. The gases are drawn through this elbow and duct by an

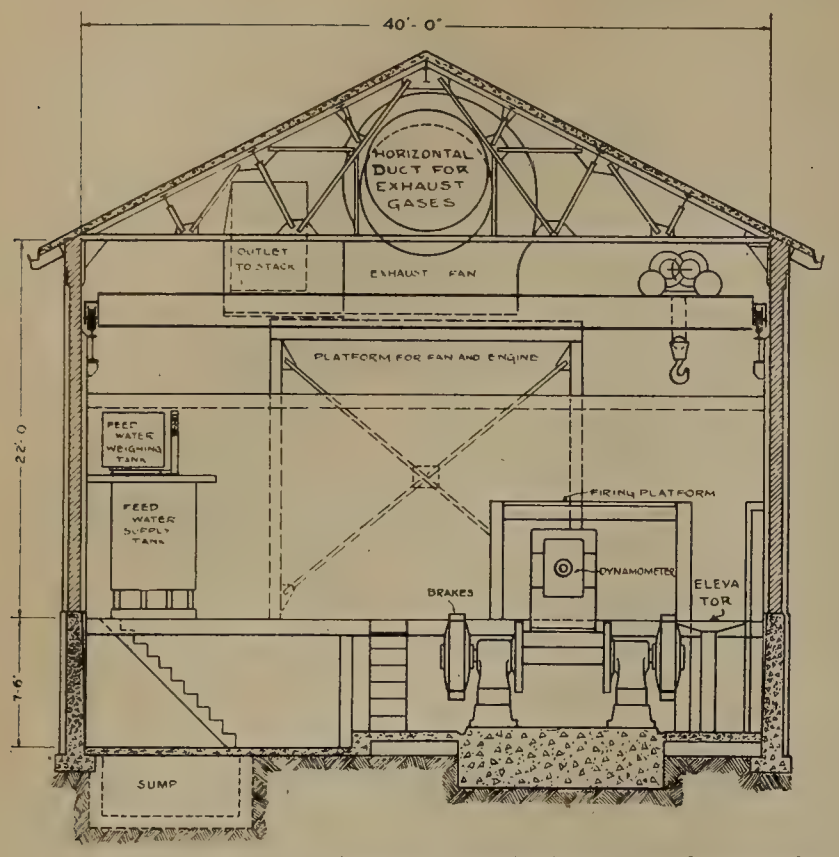


Fig. 10—Cross Section Through the Middle of the Locomotive Testing Laboratory.

exhaust fan, located near the roof at the rear end of the building. Probably the heaviest cinders will be dropped in this duct, but the velocity within it is such that all but the heaviest particles of solid matter will be carried on through the fan. Whatever does accumulate here may be removed through traps provided in the bottom of the duct, and weighed. From the fan, the gases and the remaining solid matter are passed, through a breeching or flue to the separator above referred to, the action within which may be best explained by recurring to Fig. 8. The cinder laden gases enter this separator at B and in order to leave they must pass downward and around the sleeve A. In so doing they are given a whirling motion which causes the cinders to move toward the wall along which they drop to the hopper below, while the gases pass downward and out to the stack through the mouth of the sleeve. The cinders collecting at the bottom of the hopper are drawn off and weighed. This separator is surmounted by a 45 foot radial brick stack from which the gases are finally discharged 81 feet from the ground.

The corrosive nature of the mixture of exhaust gas and steam has made it necessary to avoid the use of metal throughout this exhaust system. The exhaust elbow within the building necessarily has been made of steel, and will need occasionally to be renewed. The duct, however, is of asbestos board ("Transite") which will resist corrosion. It is 7 ft. in diameter, and made up of separate sections so that its length may be varied. The fan has a runner 6 ft. in diameter, and will pass, at maximum speed, 140,000 cubic feet of gas per minute. The breeching between fan and separator is built of transite, and has a minimum cross sectional area of about 24 square feet. The outer shell of the separator is built of reinforced concrete. To protect the shell from corrosion, it is lined throughout with a hard burnt red brick. Between this lining and the shell is a 2" air space to act as an insulator to protect the shell from undue heating. Any leakage of gas through the lining into this space is vented to the outside air through openings which are provided in the shell, and which serve also to circulate cool air through the air space. The inside sleeve and hopper are both built of reinforced concrete. The stack itself is unlined, but is laid up in acid proof cement. It is expected that this whole system will not only permit the collection of all solid matter and thus enable the front end losses to be determined in a manner beyond criticism; but that it will also dispose of the smoke so that it will be unobjectionable and at the same time act as a muffler and eliminate objectionable noise from the locomotive stack discharge.

The main features of the building which houses this equipment are shown in Figures 9 to 11. It is 40 ft. wide and 115 ft. long, with a height under the roof trusses of 22 ft. A basement with a 6 ft. 9 in. clear depth extends throughout all but 22 ft. of its entire length. The construction is fireproof throughout. The walls are laid up both inside and out with red faced brick, the roof is of reinforced concrete covered with slate, and all floors are of reinforced concrete also. The building is unusually well lighted by windows in the side walls which extend nearly the full height of these walls and occupy almost two-thirds of the wall area. All portions of the building, except the space occupied by the coal room in the west end, are served by a 10-ton traveling crane.

In the design of this plant the University has profited by the generous advice and assistance of those in charge of the laboratories at Lafayette and Altoona. Drawings and records of experience and of initial difficulties have been courteously placed at our disposal; and if in some details we shall have avoided similar difficulties, it will be largely due to this assistance which it is a pleasure thus to acknowledge. It is a pleasure also to acknowledge the part taken in perfecting the details of the design, by F. W. Marquis, H. H. Dunn, and H. B. Ketzle, members of our own railway department staff.

It is no part of our plan to own a locomotive for service in this laboratory. The whole plant has been designed with the intention of making it suitable to test new designs as they appear, in the confidence that the railroads and builders would be willing to keep upon the plant locomotives of recent design, concerning whose performance all railroad officials desire information; and we have proceeded in this plan with very generous assurance from those interested that we should not be disappointed in this expectation. The first locomotive to be tested is one of the consolidation type owned by the Illinois Central Railroad. It will be received within a few days and the plant is expected to be in operation by the middle of April. This locomotive is loaned to the University through the courtesy of W. L. Park and M. K. Barnum, whose encouragement and interest in this and many other connections we are glad to acknowledge. As is the case with the results of the work of all other university laboratories, the results obtained of this testing plant will be made public and freely available.

The new locomotive testing plant is a most important addition to the equipment of the railway engineering department and will greatly strengthen its instruction and increase its opportunities for research. There has been added to the

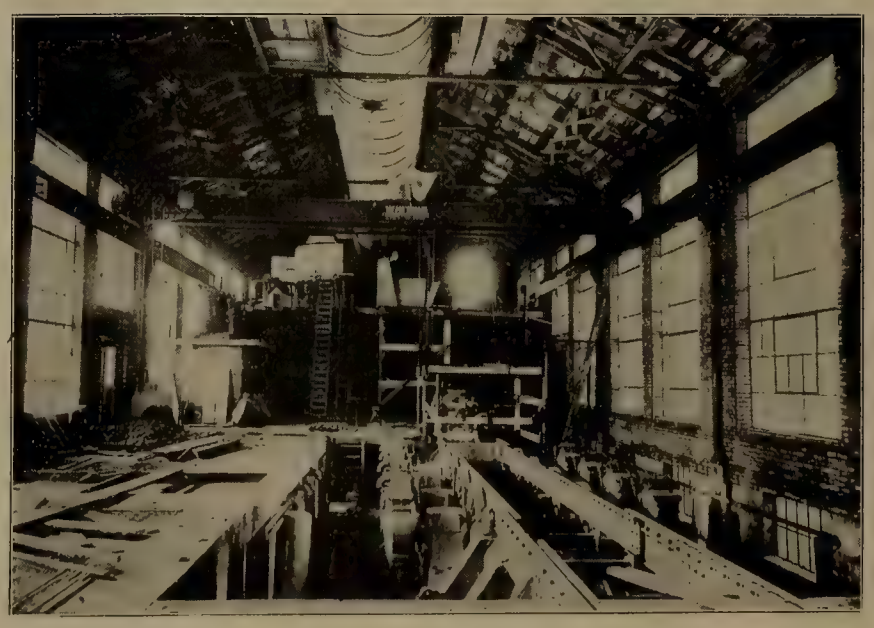


Fig. 11—An Interior View of the Partially Completed Laboratory Looking Towards the Rear.

Fig. 12—The New Transportation Building.

facilities of the railway engineering department another new building which in its influence on education for railway service at the University will doubtless prove to be in many respects an even more significant addition than the locomotive laboratory itself. The construction of this building was made possible by the same legislative act which provided funds for the laboratory. Construction was begun on this building last May, and it was finished in August.

The Transportation building was designed by W. Corbys Zimmerman, State Architect, according to general instructions and specifications prepared under the direction of Dean W. F. M. Goss. The plans provided for a building one hundred and eighty-five feet long and sixty-five feet wide. At present forty-five feet at the north end of the building are omitted, since at the time construction was started, the land upon which this portion will finally stand was not owned by the University. The building has three stories and is built of red brick with Bedford limestone trimmings. The general features of the exterior design are shown in Figure 12. The construction is fireproof, consisting of a tile protected steel skeleton, brick walls, tile partitions, and concrete floors. The roof is of reinforced concrete covered with slate. The interior finish and all furniture is of oak, the floors are of maple with the exception of that of the hall on the first floor which is of tile. The building is conceded to be one of the most attractive of the Engineering group and thoroughly appropriate for its purposes. The railway engineering department at present shares the use of this building with the departments of mining, engineering and general engineering drawing. The building provides class rooms, drafting rooms, a library, small laboratories, and offices for the use of all three departments. It is planned to be occupied eventually by the railway department alone.

Another new building situated behind the Transportation building contains at present the laboratories of the mining engineering department and the department of ceramics, which form for these departments additions to their equipment as important as are those previously described, for the department of railway engineering. This whole group forms a most significant addition to the facilities of the College of Engineering and one which will have an important influence on the work of the departments concerned. Contemplated future extensions of this group include a building similar to the locomotive laboratory which will be devoted to laboratory work in railway electrical engineering. It is expected that in the course of time the departments of mining engineering and ceramics will have larger quarters elsewhere, and that the entire group of buildings shown in the plan will be devoted eventually to the work of the railway engineering department.

In addition to the new equipment here discussed the railway department has for some years owned a dynamometer car fitted for service on steam roads, an electric test car for instruction and research on electric roads, a brake shoe testing machine, and a drop testing machine. It is believed that this apparatus, the new Transportation building and Locomotive Laboratory, with the facilities of the other laboratories of the College of Engineering, taken together, provide at the University of Illinois more complete and more adequate facilities for instruction for railway service than are elsewhere available, and that they offer opportunities for research in railway problems which are nowhere excelled. The staff of the railway department appreciates the obligations which these opportunities place upon it and feels confident that it may discharge them with some measure of success, if it continues to receive from railway officers the same interest and cooperation which have been given the department during the six years since it was organized. The action of the University administration in making at this time such an investment for railway engineering instruction is a fitting recognition of the importance of the railway interests and marks a most significant advance in technical education.

RAILWAY SUPPLY MANUFACTURERS' ASSN.

The Railway Supply Manufacturers' Association has about completed its plans for the exhibit annually made in connection with the convention of the American Railway Master Mechanics and Master Car Builders' Associations, which are to be held this year at Atlantic City, New Jersey, June 11 to 18 inclusive.

Those supply companies, which have contracted for exhibit space, are as follows:

List of Exhibitors.

Acme Supply Co., Steger Bldg., Chicago, Ill.
American Abrasive Metals Co., 50 Church St., New York, N. Y.
American Arch Co., 30 Church St., New York, N. Y.
American Balance Valve Co., Jersey Shore, Pa.
American Brake Co., St. Louis, Mo.
American Brake Shoe & Fdry. Co., Rahway, N. J.
American Brass Co., Ansonia, Conn.
American Car & Fdry. Co., 165 Broadway, New York, N. Y.
American Locomotive Co., 30 Church St., New York, N. Y.
American Mason Safety Thread Co., Old South Bldg., Boston, Mass.
American Nut & Bolt Fastener Co., Box 996, Pittsburgh, Pa.
American Piston Co., 10th & Canal Sts., Indianapolis, Ind.
American Pulley Co., 4200 Wissahicken Ave., Philadelphia.
American Roll Gold Leaf Co., Providence, R. I.
American Steel Foundries, Coml. Natl. Bank Bldg., Chicago.
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
American Tool Works Co., Cincinnati, O.
American Vanadium Co., Vanadium Bldg., Pittsburgh, Pa.
Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa.
Ashton Valve Co., 271 Franklin St., Boston, Mass.
Automatic Ventilator Co., 2 Rector St., New York, N. Y.
Baker Brothers, Post St. & Westlake Ave., Toledo, O.
Baldwin Locomotive Works, Philadelphia, Pa.
Barco Brass & Joint Co., 230 N. Jefferson St., Chicago, Ill.
Bausch Machine Tool Co., Springfield, Mass.
Berry Brothers, Ltd., Detroit, Mich.
Besly & Co., Chas. H., 118 N. Clinton St., Chicago, Ill.
Best, W. N., 11 Broadway, New York, N. Y.
Bettendorf Company, Bettendorf, Ia.
Blackall, Robert H., Farmers Bank Bldg., Pittsburgh, Pa.
Bowser & Co., Inc., S. F., Ft. Wayne, Ind.
Brubaker & Brothers, W. L., Millersburg, Pa.
Buckeye Steel Casting Co., S. Parsons Ave., Columbus, O.
Buda Company, Chicago, Ill.
Buffalo Brake Beam Co., 30 Pine St., New York, N. Y.
Bullard Machine Tool Co., Bridgeport, Conn.
Burroughs Adding Machine Co., Detroit, Mich.
Buyers Index Co., 445 Plymouth Pl., Chicago, Ill.
Camel Company, 332 S. Michigan Ave., Chicago, Ill.
Carborundum Company, Niagara Falls, N. Y.

Carey Co., Philip, Lockland, Cincinnati, O.
Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.
Chase & Co., L. C., 89 Franklin St., Boston, Mass.
Chicago Car Heating Co., Railway Exchange, Chicago, Ill.
Chicago Pneumatic Tool Co., Fisher Bldg., Chicago, Ill.
Chicago Ry. Equipment Co., McCormick Bldg., Chicago, Ill.
Chicago Varnish Co., Peoples Gas Bldg., Chicago, Ill.
Cincinnati Planer Co., Cincinati, Ohio.
Coe Mfg. Co., W. H., Providence, R. I.
Collins Metallic Packing Co., Philadelphia, Pa.
Commercial Acetylene Railway Light & Signal Co., 80 Broadway, New York, N. Y.
Commonwealth Steel Co., 1628 Pierce Bldg., St. Louis, Mo.
Consolidated Car Heating Co., 413 N. Pearl St., Albany, N. Y.
Cooper-Hewitt Electric Co., 730 Grand St., Hoboken, N. J.
Crane Company, 836 S. Michigan Ave., Chicago, Ill.
Crosby Steam Guage & Valve Co., 40 Central St., Boston, Mass.
Curtain Supply Co., 320 W. Ohio St., Chicago, Ill.
Davis Boring Tool Co., 3722 Forest Park Blvd., St. Louis, Mo.
Davis Solid Truss Brake Beam Co., Wilmington, Del.
Dearborn Chemical Co., McCormick Bldg., Chicago, Ill,
DeForest Sheet & Tinplate Co., Niles, O.
Detroit Hoist & Machine Co., G. T. R. R. and Clay Ave., Detroit, Mich.
Detroit Lubricator Co., Detroit, Mich.
Diamond Specialty & Supply Co., Harrison Bldg., Philadelphia.
Dickinson, Inc., Paul, Security Bldg., Chicago, Ill.
Dieter Nut Co., 84 William St., New York, N. Y.
Dixon Crucible Co., Jos., Jersey City, N. J.
Draper Mfg. Co., Port Huron, Mich.
Duff Manufacturing Co., North Side, Pittsburgh, Pa.
duPont de Nemours Powder Co., E. I., (Fabricoid Works), Wilmington, Del.
Durbin Auto. Train Pipe Connec. Co., Chemical Bldg., St. Louis, Mo.
Eagle Glass & Mfg. Co., Wellsburg, W. Va.
E. D. E. Company, Railway Exchange, Chicago, Ill.
Edison Storage Battery Co., Orange, N. J.
Edwards Co., O. M., Syracuse, N. Y.
Electric Controller & Mfg. Co., 50 Church St., New York, N. Y.
Electric Storage Battery Co., 19th St. and Allegheny Ave., Philadelphia, Pa.
Elwell-Parker Electric Co., 50 Church St., New York, N. Y.
Emery Pneumatic Lubricator Co., 1932 N. Broadway, St. Louis, Mo.
Equipment Improvement Co., 30 Church St., New York, N. Y.
Federal Engineering Co., 14th and Poplar Sts., Wilmington, Del.
Flannery Bolt Co., Vanadium Bldg., Pittsburgh, Pa.
Forged Steel Wheel Co., Frick Bldg., Pittsburgh, Pa.
Forsyth Brothers Co., McCormick Bldg., Chicago, Ill.
Fort Pitt Malleable Iron Co., Box 1054, Pittsburgh, Pa.
Franklin Railway Supply Co., 30 Church St., New York, N. Y.
Frost Railway Supply Co., Penobscot Bldg., Detroit, Mich.
Galena-Signal Oil Co., 17 Battery Place, New York, N. Y.
Garlock Packing Co., Palmyra, N. Y.
General Electric Company, Schnectady, N. Y.
General Railway Supply Co., Marquette Bldg., Chicago, Ill.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Gold Car Heating & Lighting Co., 17 Battery Place, New York, N. Y.
Goldschmidt Thermit Co., 90 West St., New York, N. Y.
Goodyear Tire & Rubber Co., Akron, O.
Gould & Eberhardt, 97 N. J. R. R. Ave., Newark, N. J.
Gould Coupler Co., 347 Fifth Ave., New York, N. Y.
Greene-Tweed & Co., 109 Duane St., New York, N. Y.
Greenlaw Mfg. Co., 141 Milk St., Boston, Mass.
Griffin Wheel Co., 445 S. Sacramento Blvd., Chicago, Ill.
Grinden Art Metal Co., 419 Marcy Ave., Brooklyn, N. Y.
Grip Nut Co., Old Colony Bldg., Chicago, Ill.
Hale & Kilburn Co., 30 Church St., New York, N. Y.
Hammett, H. G., 466 Eighth St., Troy, N. Y.
Harrington, Son & Co., Inc., Edwin, 17th and Callowhill Sts., Philadelphia, Pa.
Hartshorn Company, Stewart, 521 S. Wabash Ave., Chicago.
Hefenstall Forge & Knife Co., Pittsburgh.
Hewitt, H. H., 111 Broadway, New York, N. Y.
Hewitt Rubber Co., Fidelity Trust Bldg., Buffalo, N. Y.
Heywood Bros. & Wakefield Co., Wakefield, Mass.
Hobart-Allfree Co., Old Colony Bldg., Chicago, Ill.
Hunt-Spiller Mfg. Corporation, 383 Dorchester Ave., South Boston, Mass.
Hutchins Car Roofing Co., Ford Bldg., Detroit, Mich.
Illinois Steel Co., Coml. Nat. Bank Bldg., Chicago, Ill.
Independent Pneumatic Tool Co., 1307 Michigan Ave., Chicago, Ill.
Interlocking Rail Joint Mfg. Co., Chicago.
International Oxygen Co., 115 Broadway, New York, N. Y.
Jenkins Brothers, Box 2125, New York, N. Y.
Jerguson Mfg. Co., 10 Postoffice Square, Boston, Mass.
Johns-Manville Co., H. W., Madison Ave. and 41st St., New York, N. Y.
Joliet Ry. Supply Co., 40th St. and Princeton Ave., Chicago.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Joyce-Cridland Co., Dayton, O.
Justice & Co., Philip S., 421 Chestnut St., Philadelphia, Pa.
Kendrick Improved Valve Co., Box 704, Globe, Ariz.
Keystone Drop Forge Works, Chester, Pa.
Keystone Lubricating Co., 21st and Clearfield Sts., Philadelphia, Pa.
Keyoke Ry. Equipment Co., Monadnock Block, Chicago, Ill.
Knight, Inc., John C., Whitehall Bldg., New York, N. Y.
Landis Machine Co., Waynesboro, Pa.
Landis Tool Co., Waynesboro, Pa.
Lea-Courtenay Co., New York, N. Y.
Lehon Company, West 45th St., Chicago, Ill.
Liberty Mfg. Co., 6905 Susquehanna St., Pittsburgh, Pa.
Locomotive Stoker Co., 30 Church St., New York, N. Y.
Locomotive Superheater Co., 30 Church St., New York, N. Y.
Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.
Lucas Machine Tool Co., East 99th St. and L. S. Ry., Cleveland, O.
Lunkenheimer Company, Cincinnati, O.
Lutz-Webster Engineering Co., Inc., 31st and Grays Ferry Rd., Philadelphia, Pa.
Magnus Metal Co., 111 Broadway, New York, N. Y.
Manning, Maxwell & Moore, Inc., 85 Liberty St., New York.
Mark Manufacturing Co., Box G, Chicago, Ill.
Massachusetts Mohair Plush Co., 200 Devonshire St., Boston.
Midvale Steel Co., Box 1606, Philadelphia, Pa.
Milburn Co., Alexander, 1420 West Baltimore St., Baltimore, Md.
Monarch Steel Castings Co., Detroit, Mich.
Moran Flexible Steam Joint Co., 115 North Third St., Louisville, Ky.
McClellan Locomotive Boiler Co., Box 2584, Boston, Mass.
McConway & Torley Co., 48th St. and A. V. Ry., Pittsburgh.
McCord & Co., Peoples Gas Bldg., Chicago, Ill.
McCord Mfg. Co., Peoples Gas Bldg., Chicago, Ill.
McGraw Publishing Co., 239 West 39th St., New York, N. Y.
Nathan Mfg. Co., 85 Liberty St., New York, N. Y.
National Graphite Lubricator Co., Traders Nat. Bank Bldg., Scranton, Pa.
National Lock Washer Co., Johnson and Hermon Sts., Newark, N. J.
National Malleable Castings Co., Cleveland, O.
National Tube Co., Frick Bldg., Pittsburgh, Pa.
Newhall Engineering Co., Geo. M., 1421 Chestnut St., Philadelphia, Pa.

Nickel-Chrome Chilled Car Wheel Co., Frick Annex, Pittsburgh, Pa.
Northwestern Construction Co., New York.
Norton, Inc., A. O., 286 Congress St., Boston, Mass.
Norton Company, Worcester, Mass.
Nuttall Co., R. D., McCandless Ave., Pittsburgh, Pa.
O'Malley-Beare Valve Co., Railway Exchange, Chicago, Ill.
Pantasote Company, 11 Broadway, New York, N. Y.
Parkesburg Iron Co., Parkesburg, Pa.
Parsons Engineering Co., Equitable Bldg., Wilmington, Del.
Pennsylvania Flexible Metallic Tubing Co., Philadelphia, Pa.
Pilliod Brothers Co., 2915 Dorr St., Toledo, O.
Pilliod Company, Swanton, O.
Pittsburgh Steel Foundry Co., House Bldg., Pittsburgh, Pa.
Pneumatic Jack Co., Paul Jones Bldg., Louisville, Ky.
Pocket List of R. R. Officials, 75 Church St., New York, N. Y.
Pollak Steel Co., 165 Broadway, New York, N. Y.
Pressed Steel Car Co., Farmers Bank Bldg., Pittsburgh, Pa.
Pyle-Nat. Elec. Headlight Co., Karpen Bldg., Chicago, Ill.
Pyrene Mfg. Co., 1358 Broadway, New York, N. Y.
Railway & Engineering Review, 537 S. Dearborn St., Chicago.
Railway Electrical Engineer, 106 N. La Salle St., Chicago, Ill.
Railway List Co., Manhattan Bldg., Chicago, Ill.
Railway Materials Co., Railway Exchange, Chicago, Ill.
Railway Utility Co., The Rookery, Chicago, Ill.
Reed Mfg. Co., Erie, Pa.
Reliance Electric & Engineering Co., Cleveland, O.
Restein Co., Clement, 133 N. 2d St., Philadelphia, Pa.
Rochester Germicide Co., Rochester, N. Y.
Safety Car Heating & Lighting Co., 2 Rector St., New York, N. Y.
Safety Steel Ladder Co., 810 Olive St., St. Louis, Mo.
Scarritt-Comstock Furniture Co., Broadway and Locust Sts., St. Louis, Mo.
Sellers & Co., Inc., Wm., 1600 Hamilton St., Philadelphia, Pa.
Simmons-Boardman Publishing Co., 83 Fulton St., New York, N. Y.
Simplex Ry. Appliance Co., Coml. Natl. Bank Bldg., Chicago, Ill.
Sprague Elec. Works of G. E. Co., 527 W. 34th St., New York, N. Y.
Standard Heat & Ventilation Co., Inc., 141 Cedar St., New York, N. Y.
Standard Roller Bearing Co., 50th & Lancaster Ave., Philadelphia, Pa.
Standard Steel Car Co., Frick Bldg., Pittsburgh, Pa.
Standard Steel Works Co., Morris Bldg., Philadelphia, Pa.
Steel Specialties Co., 6 Beacon St., Boston, Mass.
Storrs Mica Co., Owego, N. Y.
Symington Co., T. H., Rochester, N. Y.
Templeton-Kenly & Co., Ltd., 1020 S. Central Ave., Chicago, Ill.
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Transportation Utilities Co., 30 Church St., New York, N. Y.
Union Draft Gear Co., McCormick Bldg., Chicago, Ill.
Union Spring & Mfg. Co., Oliver Bldg., Pittsburgh, Pa.
U. S. Light & Heating Co., Niagara Falls, N. Y.
U. S. Metal & Mfg. Co., 165 Broadway, New York, N. Y.
U. S. Metallic Packing Co., 429 N. 13th St., Philadelphia, Pa.
Underwood, H. B., Co., Philadelphia, Pa.
Universal Draft Gear Attachment Co., Railway Exchange, Chicago, Ill.
Valentine & Company, 456 Fourth Ave., New York, N. Y.
Virginia Equipment Co., Gardner Bldg., Toledo, O.
Vixen Tool Co., 5001 Lancaster Ave., Philadelphia, Pa.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland, O.
Waterbury Tool Co., New Britain, Conn.
Watertown Specialty Co., 124 E. Moulton St., Watertown, N. Y.
Watson-Stillman Co., 50 Church St., New York, N. Y.
Welsbach Company, Gloucester, N. J.
West Disinfecting Co., 2 E. 42d St., New York, N. Y.
Western Ry. Equipment Co., 705 Olive St., St. Louis, Mo.
Western Steel Car & Fdry. Co., Chicago, Ill.
Westinghouse Air Brake Co., E. Pittsburgh, Pa.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Westinghouse Machine Co., E. Pittsburgh, Pa.
Wheel Truing Brake Shoe Co., Detroit, Mich.

Work Car for Cambridge Subway.

Wiener Machinery Co., 50 Church St., New York, N. Y.
Wilmarth & Morman Co., Gd. Rapids, Mich.
Wilson Remover Co., 30 Church St., New York, N. Y.
Winslow Co., Horace L., Old Colony Bldg., Chicago, Ill.
Wood, Guilford S., Great Northern Bldg., Chicago, Ill.
Woods & Co., Edwin S., Monadnock Block, Chicago, Ill.
Yale & Towne Mfg. Co., 9 Murray St., New York, N. Y.
Zug Iron & Steel Co., 14th & Etna Sts., Pittsburgh, Pa.

Track.

Standard Car Truck Co., McCormick Bldg., Chicago, Ill.

WORK CAR, CAMBRIDGE SUBWAY, BOSTON, MASS.

Supplementing the passenger rolling stock of the Cambridge Subway is a work car locomotive. This car is of boxcar construction provided with a 15-ton pneumatic hoist at one end. It is used to haul rails and material throughout the right-of-way of the Cambridge Subway, and also to push the wrecking derrick. The interior of the car is provided with racks for tools and wrecking appliances.

Two Westinghouse No. 300-D, 220 h. p. commutating pole railway motors are mounted on one truck of this car and used for propelling the same. These motors are controlled by Westinghouse type AL unit switch control.

The No. 300-D motor is of the box frame construction type, the frame of the motor being cast in one piece of steel with openings bored out at each end to receive housings containing the armature bearings. These housings are accurately machined, thus making the housing of motors interchangeable and easily bolted to the frame. The box frame construction gives great mechanical strength to the motor; protects the electrical parts, and assures proper alignment of all members of the motor. Also, this type of motor is easily handled in the shop where traveling cranes are available. The commutating pole feature of this motor makes it operate reliably and economically. Heavy overloads can be handled safely, and also a large range of voltage is permissible without serious consequences which are incident to operation requiring high powered motors taking heavy currents.

By using the commutating pole type of motor, sparkless commutation is secured, and flashing trouble and brush and commutator wear are practically negligible. Bolted commutator construction insures no loose commutator or high bars. Thoroughly insulated and easily accessible brushholders are used. The brushholders have an adjustable spring tension which provides uniform brush pressure throughout the life of the brush.

The control equipment is assembled at the end nearer the motor truck, thus making everything very accessible, and only short runs of wiring necessary.

Westinghouse type AL unit switch control used on this work car is similar to that on the cars of the subway, and is well adapted to the service demanded. This control, or the automatic line current control as the letters AL designate, is especially suited for operation on elevated roads, in subways and truck lines, suburban and interurban service.

The essential difference in this type of control over the hand-operated type of unit switch control is that the acceleration of the train is secured automatically. The master controller has only three positions, which are "switching," series running, and parallel running. The "off" position is in the center. The unit switches, located in the switch group, are provided with interlocks which are electrically connected with the valve magnets in such a manner that the closing of one switch energizes the magnet of the next; thus producing automatic progression of the switches under the direction of the limit switch. This limit switch controls the rate at which the resistance is cut out of circuit, so as to give uniform accelerating current. This produces smooth and economical acceleration and also prevents abuse of equipment by accelerating in excess of the predetermined rate.

The motor equipment on this work car is a duplicate of that on the regular passenger subway cars. It is necessary to provide this car with high powered motors in order that it will not interfere with traffic in the subway.

The work car locomotive is 50 feet long over all and 38 feet between center pins.

CANADIAN NORTHERN SUPPLY CAR.

By L. C. Thomson, Storekeeper.

The Canadian Northern Ontario Railway has added to its equipment quite recently, what it considers to be the most up-to-date supply car now in use. The interior layout of this car was designed by L. C. Thomson, storekeeper, and was built under the direction of A. L. Graburn, mechanical engineer. No doubt the previous experience which Mr. Thomson had in the laying out of the C. P. R. supply cars, which were built at the Canadian Pacific shops at Farnham, some seven years ago, was of material assistance to him in making this one of the best and most complete cars for this service.

This car is of the Canadian Northern passenger car type and finish, being equipped with 36-inch steel wheels, six-wheel trucks, standard Sharron coupler, and draft rigging, and steel eye beams throughout.

The body is 66 ft. 9 in. over end sills, by 9 ft. 6 in. wide, and is equipped with Baker heater, steam line, air and whistle signal.

The living or "B" end has a platform 3 ft. 7 in. deep. Immediately inside the car, to the left, is a well finished section with removable table, which makes up into two very comfortable upper and lower berths. On the opposite side of the aisle are lockers and a heater.

We then pass into what might be called the kitchen, and office. The former consists of lockers for provisions, sink with overhead water supply, range, refrigerator, etc., while on the left is a desk with pigeon holes and a table for wrapping.

The next twenty feet is fitted with shelving in sections, being very complete, some operating from the main aisle with sliding doors, while most operate from the side aisle, into which the side windows throw their light. Every inch of available space has been taken advantage of in this section. As we leave this quarter on our left, there is a very complete lavatory, opposite to which are large lockers lined with galvanized iron and asbestos, for the storage of matches, fusees, torpedoes.

The balance of the car is laid off as a baggage section, the floor being lined with galvanized iron, with soldered joints, while drips below the floor allow for a thorough washout. Upon this lies the usual oak slatting. Here are two Bowser oil tanks and pumps for the carrying of journal and signal oils. There is a sliding door on each side, 4 ft. wide, which are ingeniously made to keep out snow. From these doors all supplies are issued and no one but those in charge have access to car.

At the extreme end we have a large Bowser tank and pump for headlight oil. These tanks filling from underneath the car make one of the cleanest and safest arrangements we have seen. The "A" end of the car has an end door, and is of the standard baggage car design with diaphragm.

The car is lighted with six Adlake No. 190 double centre lamps and two side bracket lamps.

This car is being operated on the company's lines in Ontario, chiefly in freight service, which gives the superintendents and roadmasters, as well as the storekeeper, an opportunity of going over the road together at least once a month when supplies are being distributed and old material picked up. In this way, all get in touch with the conditions at each station, and matters which may arise are settled at once, which brings results. This is the idea advocated by the Railway Storekeepers' Association, and is proving most economical and efficient.

Three-Cylinder Locomotives, North Eastern Ry. of England

A new type of locomotive has been designed by Vincent L. Raven (M. Inst. C. E., & M. I. Mech. E.), chief mechanical engineer of the North Eastern Ry. of England. It is of the 4-4-2 Atlantic type. A series of these engines were built at the works of the North British Locomotive Company, Ltd., Glasgow, as they were urgently required, and the railway company's own shops were rushed with other work.

The engines in question, of which, by the courtesy of Mr. Raven, we gave sectional drawings and other illustrations, have four wheels coupled, a leading bogie, and a pair of carrying wheels under the fire-box. The coupled wheels are 6′ 10″ in diameter, the bogie wheels being 3′ 7¼″ in diameter while the carrying wheels are 4′ 0″ in diameter.

The cylinders are three in number, and are all cast together along with chambers for piston valves, one central with piston valve on top, and two outside the frames with piston valves inside frames.

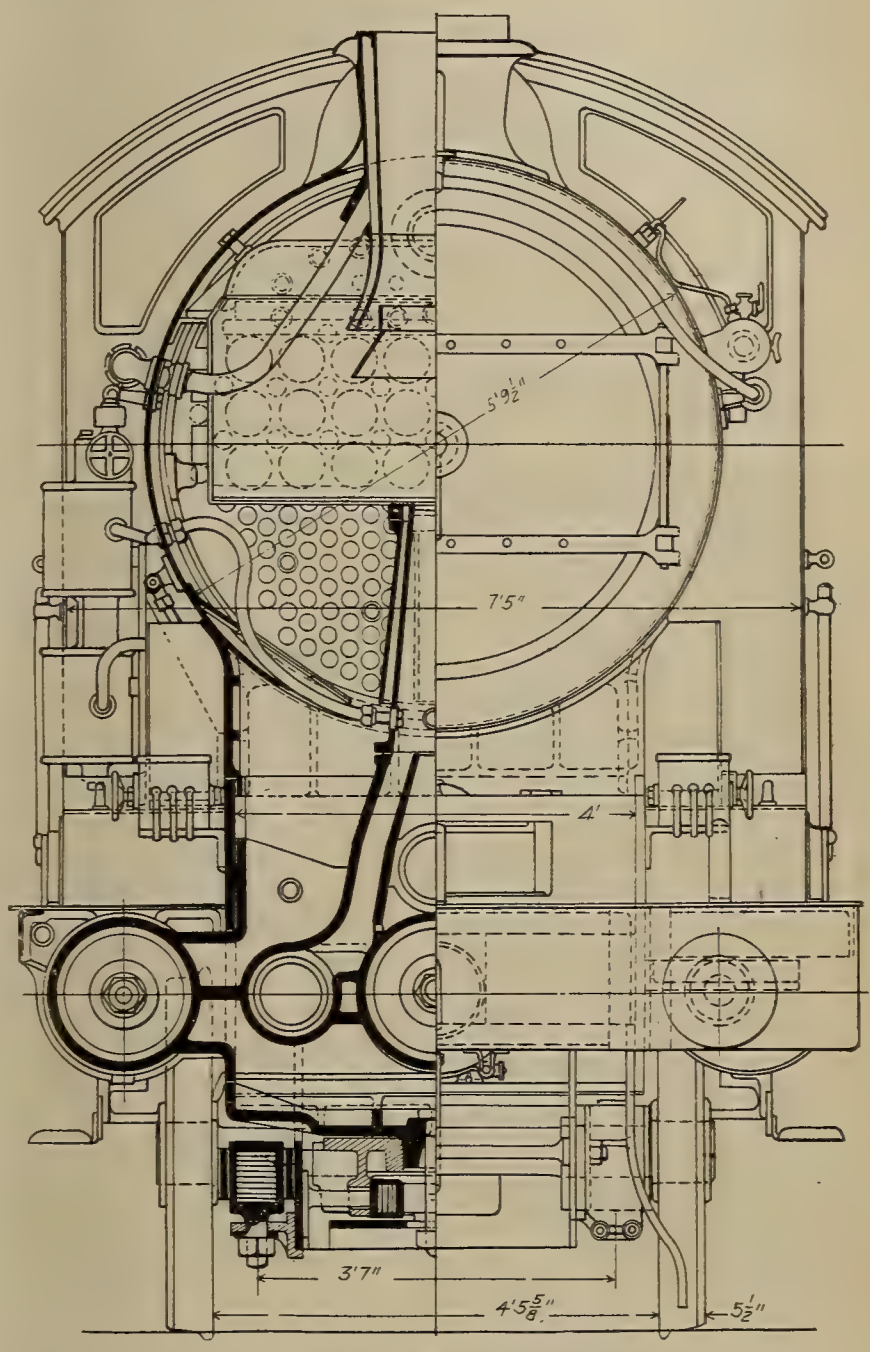
Ten of the above are saturated steam engines, and ten are superheated. The saturated cylinders are 15½″ in diameter, and the superheated cylinders are 16½″ in diameter. All the engines are alike in other details. The superheated engines are fitted with ''Schmidt'' system, which is capable of maintaining 650 degrees of heat.

These engines are the first passenger engines built for an English railway with three cylinders and valve chamber in one casting. The steam chamber is common to all three cylinders, and three exhausts are carried to the centre and exhaust into one pipe fitted with ash ejectors (covered by patent) which throw the ash out of the smoke-box through the stack thus preventing the ash from accumulating in the smokebox, and blocking the bottom row of tubes. Very little ash is found in the smokebox after a trip of some 160 miles.

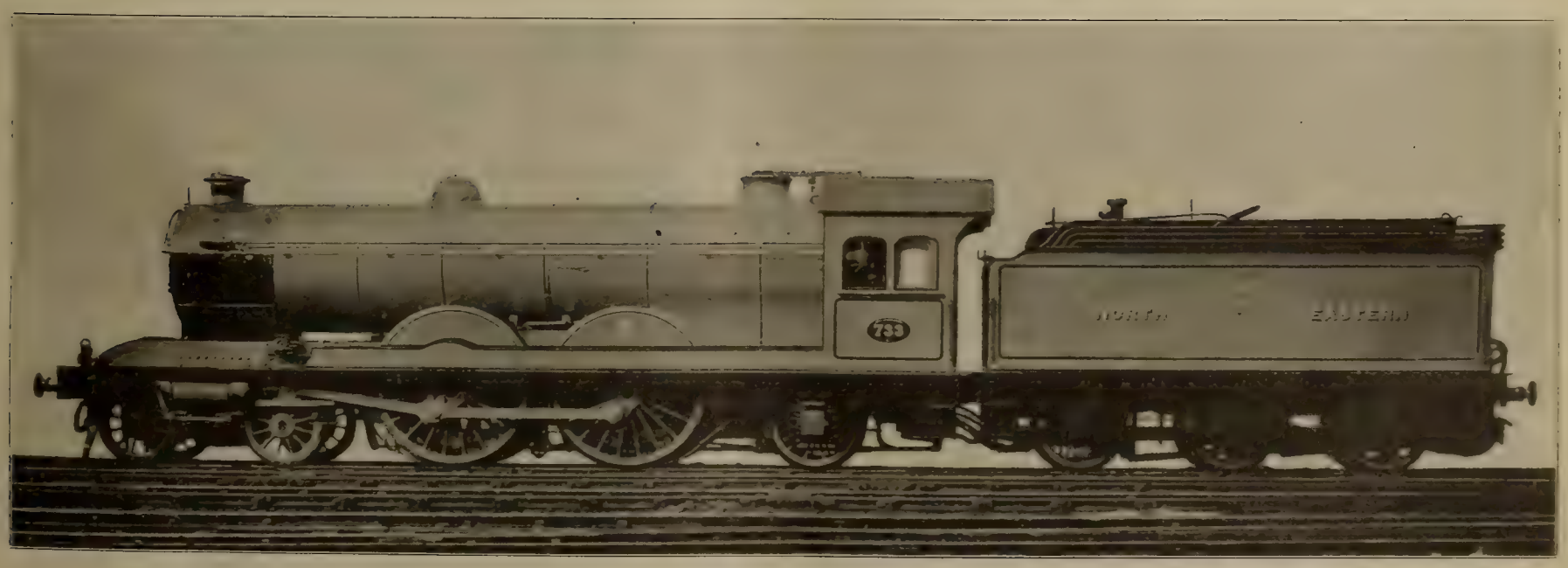
The smokebox door is fitted with an asbestos ring to keep it air tight, this ring being fitted into an iron ring which is riveted to the smokebox front plate and the door being turned fits on to the asbestos ring.

The engines are built to deal with the heavy East Coast passenger traffic between York, Newcastle and Edinburgh and have given every satisfaction, hauling trains varying from 300 to about 500 tons behind the tender at average speeds up to 53 M. P. H.

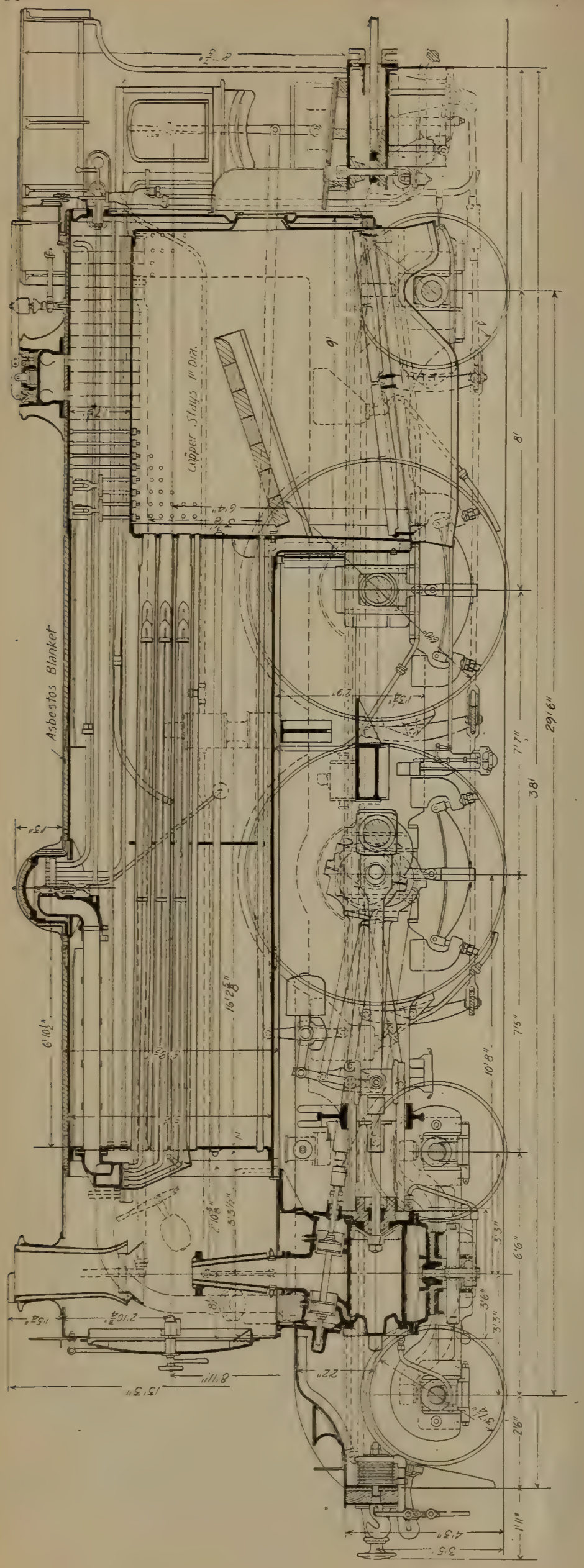
The consumption of coal by the saturated steam engines is lighter than that of the previous engines working in the same

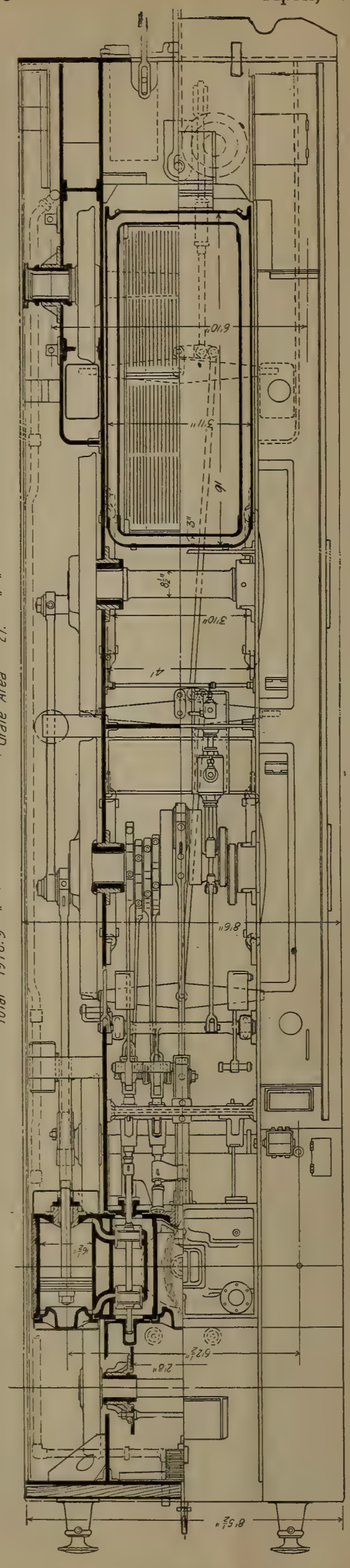


Cross Section of Three-Cylinder Locomotive.



Three-Cylinder Atlantic Type Engine for the North Eastern Railway of England.





Elevation and Plan View of Three-Cylinder Locomotive, North Eastern Railway of England.

traffic, while the consumption of coal of the superheated engines is considerably lighter still.

With superheater, the weight in working order is 154,200 pounds and without the superheater the weight in working order is 153,400 pounds. The superheater engines have 1,798.9 sq. ft. of heating surface in the tubes and 180 sq. ft. in the firebox, making a total of 1,978.9 sq. ft. The superheating surface is 530.1 sq. ft. and the grate area on both superheater and saturated engines is 27 sq. ft. The saturated engines have a tube heating surface of 2,160 sq. ft., which together with the firebox heating surface of 180 sq. ft. makes a total of 2,340 sq. ft. The engines are equipped with four 4¼-in. safety valves. The working pressure on the saturated engines is 180 pounds and on the superheater engines 160 pounds.

The principal dimensions will be seen on the published drawings.

NEW STANDARD ALL-STEEL POSTAL CAR.

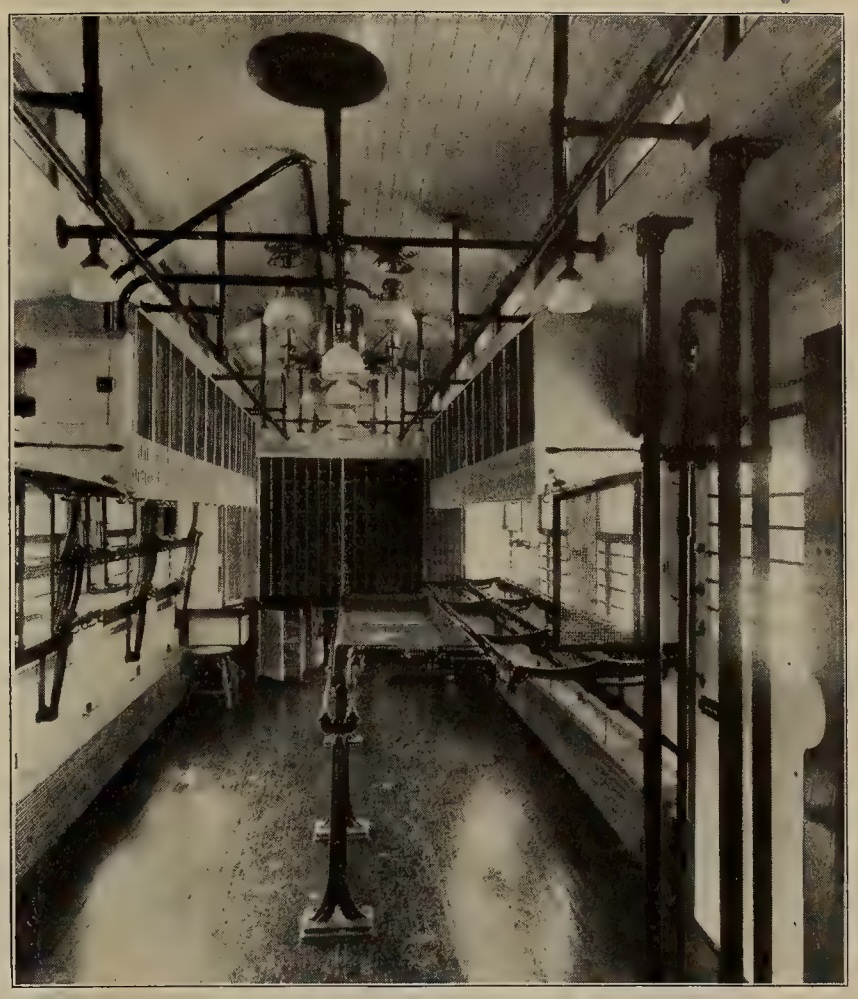
The accomplishment of a standard all-steel postal car is a decisive step toward the unification of passenger train car equipment. While the specifications and drawings of the railway mail service department are not restrictive as to design of construction, permitting as they do all known designs now in use, a specific minimum of strength of all parts of the structure is required, obtaining a similarity of frame-work, consistent with each builder's methods and facilities.

For the interior of the car a definite standard has been obtained. There is but one plan for each standard length of full postal car or mail apartment. The railways will, in a measure, profit and the post office department should derive great benefit from this uniformity of equipment.

Much thought has been given to the interior fixtures with a view toward perfection of arrangement and detail. A great deal of space has been economized over the old arrangement of interior, principally in the requirements for pouch-rack fixtures.

To the Harriman lines is due the distinction of having put in service the first all-steel full 60-ft. postal car built to the new R. M. S. specifications and drawings, ten of which cars were completed at the Pullman Company's plant during last month. The interior of this car which is typical of the new standard interior arrangements and metal detail, is shown herewith.

Interior of Standard Steel Mail Car Equipped With Rausch Pouch Racks, Harriman Lines.



30-Foot Mail Apartment of Santa Fe Car, Equipped With Rausch Pouch Racks.

An interior view of a 30-ft. mail apartment car built to the new standard which the Atchison, Topeka & Santa Fe has recently put into service.

Noticeable in the photograph reproductions of the car interiors is the pouch rack of the type known as the "Rausch Pouch Rack." It is handled by the Tinsley Railway Supplies & Equipment Company, McCormick Building, Chicago, Ill. It is an admirable design of "unit" section rack, combining lightness in weight with maximum strength and simplicity, having a minimum number of operating parts. All of the castings for the wall racks and for the center rails as well are of malleable iron. The maximum height at side wall above the floor for heating pipes is provided.

The photographs illustrate the method of operation of the rack; each rack section when not in use may be independently swung upward and locked to the side wall by means of automatic hooks. This feature enables the car being "dressed" before the trip, as the mail bags hang clear of the floor at all times; and when the rack is up out of position the maximum unobstructed area of space for storage is provided—an essential feature since the advent of the parcels post. The rack may also be locked down in position.

There is said to be a saving of more than 1,200 lbs. in the weight over the old standard pouch rack equipment for a full sixty foot car and proportionate saving in weights of shorter lengths of mail rooms. Combined with this lightness in weight, great rigidity of the rack arms is accomplished by means of a neat arrangement locking the rack arm support to the wall bracket thus preventing a swaying movement of the rack arms.

EXECUTIVE COMMITTEE DISCUSSIONS, C. I. C. I. & C. F. ASSOCIATION.

A summary of the work of the executive committee meeting of the Chief Interchange Car Inspectors & Car Foremen's Association, held at Chicago, February 21, 1913, was given on page 114 of the March issue of the *Railway Master Mechanic.* Due to lack of space, the discussions were omitted, and we herewith give a number of these discussions:

Mr. Schultz—I would suggest that the second paragraph of rule 2 be changed to read as follows: "Empty cars offered in interchange must be accepted if in safe and serviceable condition, the receiving line to be the judge in cases not provided for in rules 3 and 4 and 32 to 88, inclusive. Empty cars offered in interchange to be applied on orders must be made suitable for the lading intended before delivery. Owners must receive their own cars when offered home for repairs if properly carded for all delivering line defects, except as provided for in rule 121."

Mr. Chairman, I would like to have the gentlemen discuss my suggestions, because I may have something in here that may not be practical, and this is a chance to criticize them.

Mr. Wymer—The way Mr. Schultz read that I believe is not quite the way the committee was working yesterday. It seems as if some things that were recommended have been overlooked, and that does not take care of the car that might be moving home in the regular course of business. He says "cars to be applied on orders." Now the way the matter was discussed yesterday after two committees had been over the proposition was that the rule should remain the same down to "owners" and then another paragraph inserted something like that—I forget just what it was, but—"Order cars should be placed in serviceable condition for the lading intended by the delivering line," and then the next paragraph was—"Owners must receive their own cars when offered home for repairs if properly carded."

Mr. Schultz—I suggest that Mr. Wymer's suggestion be substitued for those that I made.

Mr. Boutet—Again, Mr. Chairman, I make the appeal to the members that I did this morning, as I believe that the changes made in the rules have been of great benefit to all of us in the matter of interchange of cars.

I believe that our association should feel highly flattered because the Arbitration committee gave us everything that we asked for, with the one exception of the rule in regard to sending home of worn-out cars, and I believe that we should give them a vote of thanks.

I do not believe that we should now begin to ask for radical changes to be made in the rules before we have had the rules in operation six months, but we will have to admit that the rules that went into effect November 1st have made a big improvement in the movement of cars.

What we have been trying to get for seven years we have accomplished, and we are working under the rule that car owners' defects under one condition are car owners' defects under all conditions.

Now that we have obtained what we have been asking and begging for during the last seven years, to come along and ask for a lot of new rules, before we have had a chance to give same a thorough trial, seems foolish to me. It seems that when we get a foot we want a mile.

I believe that we will stand better before our officials when they are aware of what we have asked for, and what we have been granted, if we did not ask for a lot of new rules.

There are other associations that are going to make recommendations, and I am afraid that it will get so that the Arbitration committee will say that the C. I. C. I. & C. F. Association is never satisfied.

I am in favor of giving these rules a trial of at least a year and then, if we find something that we think would be better, to make recommendations, but we cannot expect to get all the changes in one year. If we accomplish as much every year as we did last year it will be a matter of a very short time before we will be able to get all the rules that affect interchange on a half dozen pages of the rules. I trust that you will see this in the same way that I do.

Mr. Schultz—The very fact that I made a suggestion in the first two rules is not evidence that we are going to demand too much. The changes proposed are merely corrections in the wording which have caused any amount of annoyance in the last year. The correction in the first paragraph of rule 2 is absolutely necessary, in my mind, for a number of reasons. On account of the wording of this rule loaded cars are being held up in the delivering line yard and promptly inspected. Upon their receipt in the yard of the handling line, they are again inspected. Not only is this inspection a duplicate, but it delays the cars twice. This change in the rule is intended to permit the arrangements to be made that are the most feasible at an interchange point for the benefit of tank cars.

The changes as to the second paragraph in rule 2 came to my mind after reading the last decision of the Arbitration committee, in which they found it necessary to rule on the wording of this rule, that the owner could refuse his own car when offered with such defects as a slid flat wheel, and any changes I may make will be along the line of correction in the legality of the rule. The question of home route cars is also taken care of.

Mr. Stark—I feel quite in sympathy with the remarks of Mr. Boutet with reference to changes that might be suggested. I don't know of a time when we have had about what we wanted as nearly as we have it today, and we should be exceedingly careful in our suggestions so that we will not abuse the privileges, I may say, that we enjoy today. I think perhaps we ought to be a little delicate about even the suggestions we make to the Arbitration committee, because I think perhaps they feel quite competent to arrange such matters themselves, and that we make our suggestions in as short a way as possible, and make only such suggestions as seem only absolutely necessary; I think that the proper thing to do at this time.

Rule 120.

Mr. Schultz—Transportation officials, as well as mechanical officials, agree from practically every point of view that to move a worn-out car that has become unserviceable many miles in a revenue train, and that the owner will destroy when he gets it home, has outlived its day. The attention of the I. C. C. has repeatedly been called to the fact that we are hauling these cars, that we do so unwillingly, and any injury to employees or damage to property we understand the handling line would be responsible for, and for that reason we feel there is need for some definite action about the handling of such cars. My correction for this abuse is to eliminate the home route card and by doing this remove the only incentive that the car owner now has to avoid his responsibility, and I propose the following rule: "A car unsafe to load account of general worn-out condition shall be inspected by a representative of the reporting line and a representative of a disinterested line, who shall make report in triplicate, the original to be forwarded to the car owner and one copy to be retained by the reporting line. This report shall give in detail the defects found upon the car. Upon receipt of this information, the owner of the car shall authorize the reporting line to either make repairs or destroy the car at the owner's expense, allowing the proper credit." I make that as a motion. As a matter of further explanation in regard to handling per diem, my suggestion is per diem to cease from the date upon which inspection is made to date upon which repairs are completed, which must be within a certain number of days (it has been suggested that ninety days would be the proper time, after authority has been received).

Mr. Boutet—I hardly agree with Mr. Schultz, but I think his ideas and mine are about the same, so far as getting rid of worn-out cars is concerned. Say they were possibly three

or four hundred miles from home, the home route will call for a route of some seven or eight thousand miles alone, and instead of starting them in the direction of home, they start them in the exactly opposite direction in a great number of cases. I wrote up what I thought would be the proper interpretation of rule 120, which says: "A car unsafe to load account of general worn-out condition, due to age or decay, shall be reported to its owner, who must be advised of all existing defects."

The owner may send one of his representatives to have the car examined or demand that the car be inspected by a representative of an Interchange Bureau or a representative of the head of a car department of a disinterested line, and if the statement, as made by the person having the car in his possession, is found to be correct, the owners shall immediately on receipt of such advice advise the disposition of the car, which must be done in either of the following ways:

1st. He may have the car repaired at his own expense.

2d. He may have the car destroyed, the person destroying same allowing owners scrap credit for all metal parts of the car.

3d. He may furnish home cards over the shortest possible route, as per Sec. F, rule 3-A, of the Car Service Rules.

If the owner elects to have the car sent home, he shall furnish two home cards, noting upon them the existing defects and the route over which the car is to be returned to its owner.

Now, it would be all right to take the man's word that has the car in his possession, but there are very often misstatements made regarding the condition of a car, by a great number of lines, not with the consent of the officials of that line, but the misstatements are made by the car foremen. They may represent that they have a car in such a condition, but when the car gets home it will be found not to be as represented. Now we provide a way to avoid this, by having a representative of the Chief Interchange Inspectors' Bureau or the head of the car department of a disinterested line examine the car. In wording this there was no intention to put it in the hands of the Chief Interchange Inspector or his bureau, but simply with a view to getting a plain statement of facts. I do not think there is any employe connected with an Interchange Bureau in the United States that would go to any of the lines that he is working for and examine a car and make a misstatement to the owner after examining it, but if the owner had any doubts he could call upon the head of the car department of the disinterested road, and he would send somebody there, if we can get the consent of the owners throughout the country, who shall have the whole say as to whether the correct statement was made in regard to the condition of the car.

We all want to get rid of this. It is a dangerous proposition, and I think we have here an amendment which handles this, although we don't care so much exactly how the article is worded, so as we get rid of hauling old worn-out cars around the country.

Mr. Schultz—Mr. Boutet's interpretation of our present rule is practically correct, although it is not along the line of what I have in mind. My idea is to entirely eliminate the present rule. This is the substitute which I propose: "A car unsafe to load account of general worn-out condition shall be inspected by a representative of the reporting line and a representative of a disinterested line, who shall make report in triplicate, the original to be forwarded to the car owner, and one copy to be retained by the reporting line and one by the representative of the disinterested line. This report shall give in detail the defects found upon the car. Upon receipt of this information the owner of the car shall authorize the reporting line to either make repairs or destroy the car at the owner's expense, allowing the proper credit."

The rule I submit here does not prohibit a car owner from sending a representative if he chooses. On receipt of such information he may still send a man if he sees fit.

HOW TO LOCATE DEFECTIVE WHEELS.*

The educational bureau of the Illinois Central R. R. has recently issued an instruction booklet on "How to Locate Defective Wheels," which is one of a series on car building and repairing which is to be issued by the bureau under the supervision of D. C. Buell. This, as well as other bulletins, is protected by copyright. The purpose of the pamphlet is to assist in promoting safety on the road and copies are distributed to car inspectors and shop men working on wheels and axles. After taking up defects which occur in the foundry the booklet takes up defects at the railway shop and defects on the road.

Defects at the Railroad Shop.

The fact that wheels pass the foundry inspector and the railroad inspector at the foundry is no indication that they will pass inspection at the railroad shop when being mounted, as additional defects listed below may develop.

1st. Hubs may be found to be hollow when they are being bored.

2d. The metal in the bore may be found to be too hard to be machined, and the core of the wheel found to be in bad condition.

3rd. Warped wheels may be discovered.

4th. The process of fitting the wheels may develop flaws which have been "doctored" by preparations of various kinds at the foundry.

5th. Cracks in brackets and plates may be discovered.

6th. A wheel may be discovered on which the maltese cross preceding the wheel number has been mutilated, indicating previous rejection.

These and other miscellaneous mechanical causes may require the rejection of wheels before they are put in service.

This company has adopted the system of having a maltese cross cast on the wheel preceding the wheel number. When a wheel is rejected the inspector mutilates this cross so that should a rejected wheel be shipped to the railroad company, the shipping error can at once be detected. When a wheel is found with a maltese cross mutilated, the wheel should be again rejected and the fact immediately reported to the superintendent of the car department and the engineer of tests.

When starting to bore the wheel fit, it may be discovered that the metal is too hard for proper machining. This difficulty can sometimes be overcome by chipping away enough metal to start the tool, but if this is not successful the wheel may be rejected.

While boring the wheel it may be discovered that the hub is hollow. If so, experience will guide as to whether the wheel should be rejected or not. The core may also be found to be in bad condition. No fixed rule can be given for guidance in such cases; practical experience being required.

While handling wheels and fitting them up defects that have passed previous inspections may be discovered. Wheels that are warped may be found, hollow rims may be discovered, cracked brackets and plates may be located and discovery may be made of flaws which have been "doctored"; that is, painted up, filled with soft metal or some sort of preparation in the attempt to deceive the inspector and prevent the rejection of the wheel. In all such cases, of course, the wheel should be held and proper report made.

After the wheels have been mated they are bored to proper size with not less than two cuts. Too great care cannot be exercised in properly mating the wheels; that is, mounting two of the same tape size on an axle.

The wheel fit is turned to such a size as will allow the wheels to be forced on to the axle under heavy pressure. The axle should be fitted to the wheel—not the wheel to the axle. The fits must be such that wheels for cars of 60,000 pound capacity will go on their axle under a pressure of not less than 35 tons and not more than 45 tons; for 80,000 pound-capacity cars, the

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pressure should be not less than 45 tons and not more than 55 tons; and for 100,000 pound-capacity cars the pressure should be not less than 55 tons, or more than 65 tons, unless special instructions to the contrary are given. If less pressure than specified forces the wheel into place, the wheel should be removed from the axle and replaced by another one which will have such a fit as will require the proper pressure to put it in place. The maximum pressures stated are sufficient, and if greater pressure than that allowed is used, and as a consequence the wheel is cracked, or burst, the responsibility rests with the company's employes, and no reclaim on account of the cracked or burst wheel can be made against the manufacturer.

It may be seen from the above that special gauges (preferably micrometers) should be used when turning axles and boring wheels and should be kept in good condition, and tested frequently enough to make sure of their correctness. Boring mills should be tested frequently enough to insure wheels being bored true and central. Every wheel must be carefully inspcted for a cracked hub immediately after being pressed on an axle.

In addition to forcing the wheels in place with the proper pressure, great care must be exercised to gauge the work properly so that when finished each wheel will be exactly the same distance from the middle of the axle in addition to being exactly the correct distance apart from each other on the axle. The gauge should be applied at various points around the circumference to insure that the wheels are not warped.

Wheels mounted too closely together produce a stepped tread on each of the pair; when too far apart, cut flanges and thin flanges result. A stepped tread will also be produced if one wheel is mounted closer to the middle of the axle than its mate. It can thus be seen that a careful mating and mounting of wheels in the company shops is most essential; incorrect mating and mounting often leading to serious results. For this reason suitable reports of such work should be kept in the wheel shops for reference.

It might be added that wheels are classified as follows:

First-class includes all new wheels.

Second-class includes all second-hand wheels suitable for further service.

Third-class includes all wheels unfit for further service.

Second-class wheels removed from passenger equipment or tenders, and unfit for further service in that class of equipment, can be transferred to freight service. Third-class wheels, or wheels unfit for further service, should be condemned and the maltese cross preceding the wheel number mutilated accordingly. Second-class wheels showing a tendency to wear at the throat of the flange should be mated together; likewise, wheels showing a tendency to wear away from the flange should be mated.

When reboring second-class wheels, the thickness of the metal left in the hub must never be less than one inch.

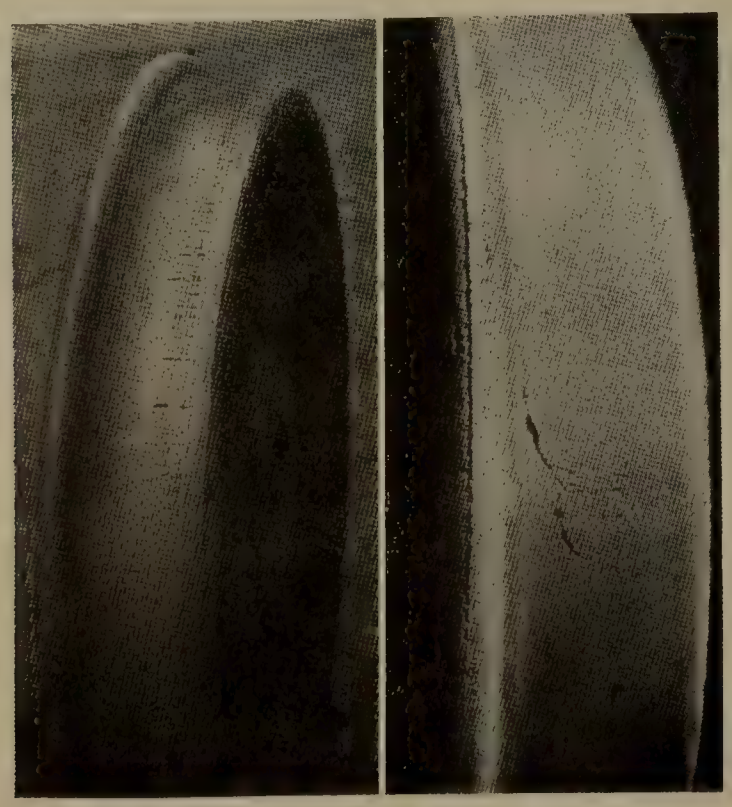


Fig. 2.

Defects on the Road.

Defects of wheels that develop on the road may consist of defects already mentioned which have not been caught by the foundry inspector, the railroad inspector, or by inspection when the wheels were fitted up at the railroad shop. What has previously been said about rejection and renewal would apply to all such cases. In addition to such defects, however, actual use of the wheels in road service is liable to produce other defects, described in the following paragraphs:

One of the most common causes requiring renewals of wheels in road service is due to wheels being slid flat. Slid flat wheels are caused by:

1. Brake leverage too strong for the weight of the car.
2. Too high pressure of air carried in the train pipe.
3. Piston travel too short.
4. Faulty triple valves.
5. Improper designing, or improper hanging of the brake-beam.
6. Wheels being oblong instead of truly round.
7. Improper handling of the air or hand-brakes. These causes will be discussed in the order given.

The brake leverage of the car should be calculated so that on freight cars 85 per cent of the light weight of the car is braked, and on passenger cars so that 90 per cent of the light weight of the car is braked.

Standard train pipe pressure should be carried in all cases, because leverage is figured on the basis of the standard train pipe pressure, and if a higher pressure is carried trouble will result. The standard pressure on the road is 70 pounds.

The limit of piston travel for freight cars is not less than 5 inches, nor more than 9 inches; the standard travel being 7 inches. For passenger cars the limit is not less than 6 nor more than 8 inches; 6 inches being the standard travel. This latter also applies to tenders. The operation of the air-brake is such that if the piston travel is less than the minimum amount allowed, there is danger of obtaining too high a pressure on the brakes even although standard train pipe pressure is being carried.

Faulty triple valves as a rule can be located only by those understanding the operation of air-brakes. Brake-beam hangers should be properly designed and hung so that the center line of the hanger makes a right angle with a line drawn from the center of the wheel, to connect with the central point of contact of the brake-shoe against the wheel.

On wheels that are oblong instead of truly round, there is, of course, a tendency of the brake-shoe, when the brake is applied, to catch and hold the wheel as the largest diameter comes against the shoe.

Improper handling of the air-brakes may cause brakes to stick or fail to release after the train has come to a stop; or, on starting the train, one or more pairs of wheels under such a car may start off sliding instead of revolving. Setting up hand-brakes too hard (with a club), or leaving hand-brakes set when starting to move a car may also cause one or more pairs of wheels to slide. Even if the tread of cast-iron wheel is of good mixture, the friction between the rail and the wheel when the wheel is sliding will ruin the iron at the point of contact of the wheel with the rail; that is, at the location of the flat spot. The amount of damage will depend on the distance the wheel slides and the character of the surface of the rail it is sliding on; that is, whether the rail is wet, dry, greasy or sandy.

As a general rule when wheels are slid flat the nature of the metal at the flat spot is changed, and the wheel becomes comby, as illustrated in Fig. 1. When both wheels on the same axle

have the same defect at points opposite each other there is hardly any doubt but that the original cause for the comby or defective spot was that the wheels had been slid flat.

Brake burns on the tread of wheels are caused by over-heating the tread of the wheel by continued pressure of the brake-shoe against the wheel. Brake burns are especially liable to occur when trains are operated down long grades, unless care is taken to prevent the wheels from becoming overheated. Fig. 2 illustrates brake burning. The sectional view of the tread of a wheel illustrated in Fig. 3a shows a black spot where the structure of the metal in the wheel has been changed. This black spot is due to a brake burn. As can be seen from Fig. 2, cracks at a right angle to the tread of the wheel develop from brake burning and the tread eventually becomes comby (see Fig. 1) from this burning, and thus causes rapid deterioration of the wheel. Care must be exercised in distinguishing brake burning from defects which may be due to the effects of over-heating. Brake burned wheels should be replaced when the tread becomes defective from excessive deterioration due to this cause; that is, in general when the area of the flattened, burned or comby part of the tread spreads out over a length of 2½ inches. There is no fixed rule for this, however, and the decision must rest more or less on the good judgment of the inspector.

Fig. 1.

Road service may show up a seamy tread that might not before have been apparent. Fig. 3 shows a case of this kind. The cause has been explained in a previous paragraph. A seam one inch long or over at a distance of ½ inch or less from the throat of the flange, or a seam 3 inches or more long on any other part of the tread, is sufficient cause for removal of the wheel. As this defect occurs in manufacture, such a wheel will be replaced by the foundry.

Fig. 4 illustrates several shelled out wheels. What causes wheels to shell out has not yet been satisfactorily explained. Some segregation of the metal during the process of manufacture leaves this weak spot. Inspection of the wheel before it goes into service will seldom, if ever, show up this defect, but as soon as the wheel goes into service, the defect develops. A small

Fig. 3.

Fig 3a.

shell out does not necessarily mean that the wheel must be removed. The appearance of the shelled out wheel will readily determine whether or not the wheel should be taken from service. The same general rule that applies to slid flat wheels, applies to shell outs; that is, a shell out the length of which is 2½ inches or more would be sufficient to require the removal of the wheel, or if numerous shell outs occur around the tread, the wheel should be removed. The good judgment of the inspector, however, must be relied on in cases where the shell out is less than 2½ inches. The shell out is a foundry defect; therefore, all shelled out wheels are subject to replacement by the foundry.

Fig. 5 illustrates a case where service has worn down the tread of the wheel through the chill. This wearing may occur throughout the circumference of the wheel, or it may occur only

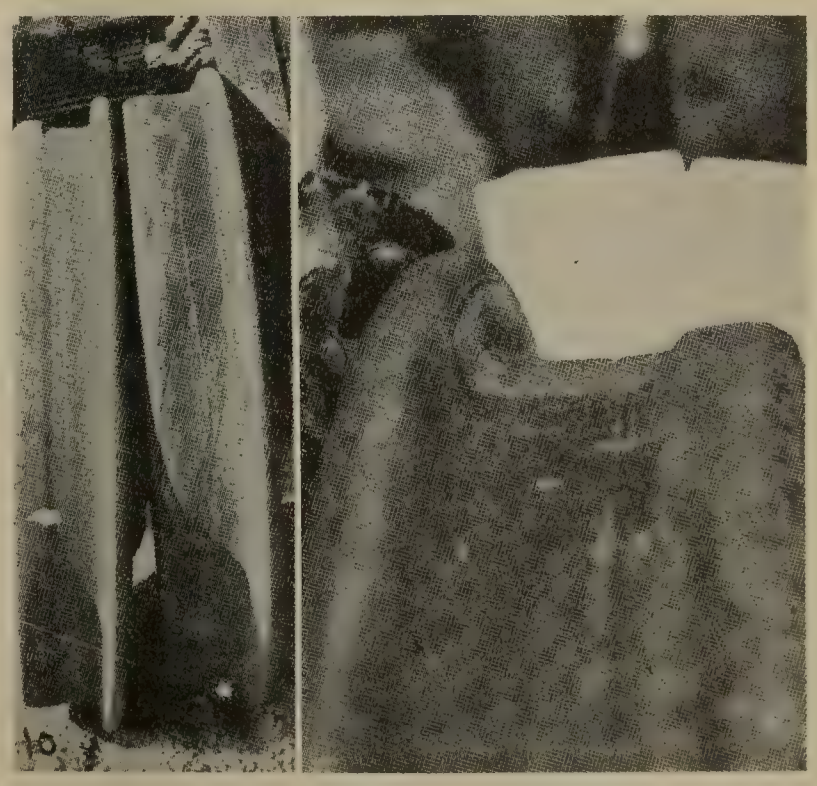


Fig. 5.

in spots. This is simply a case where the wheel was too soft to render the service guaranteed by the maker, or, in other words, it has failed to give the guaranteed mileage. Such a wheel should be removed if the worn spot is over 2½ inches long, or if the wear extends clear around the circumference and is below the M. C. B. gauge limit. (See Fig. 12.) Such wheels will be replaced by the foundry; proper credit being allowed the foundry for the mileage that the wheel has actually made. Care must be taken to distinguish this defect from flat spots caused by sliding.

Fig. 4.

Fig. 6 illustrates a wheel with a chipped rim. (It will be noticed that the rim of the wheel illustrated at the left was seamy.) This usually is caused when wheels are passing over frogs and switch points, due perhaps to worn rails or other parts of the switch layout, sharp flanges on wheels, or defective maintenance at switches or crossings; any one of which may permit the rim of the wheel to strike one of the rails of the

Fig. 6. Fig. 7.

layout, instead of being raised so as to ride it. Whether or not the wheel should be removed on account of a chipped rim can be accurately determined by the use of the M. C. B. gauge, as illustrated in Fig. 7. Should the defect extend within the gauge limit mark (the inside edge of the outer notch when gauge is placed as shown in the figure), the wheel should be condemned; otherwise, it may be left in service. The wheels shown in Figs. 6 and 7 were condemned for this cause as indicated by the M. C. B. gauge.

The chipping of flanges may occur on the inside of the flange, as shown at A, Fig. 8, or on the throat side of the flange as shown at B, Fig. 8, and in Fig. 9. Chipping is usually

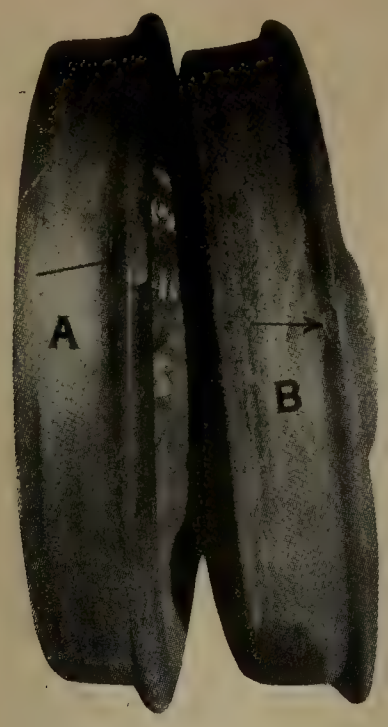


Fig. 8.

Fig. 9.

caused by trucks being loose; that is, by their having too much play at the center casting; or, it may be due to improper mounting of wheels, or to the striking of the flange against guard rails or parts of frogs, including crossings, that are out of line, or to the striking of some foreign object lodged in the throat of a frog.

If the chipped place is on the inside of the flange; that is, away from the gauge side, there is no necessity for condemning the wheel, but if the chipped portion is on the throat side of the flange, the standard M. C. B. gauge should be applied at the place where the chipping is out, and if the chipping is beyond

Fig. 10.

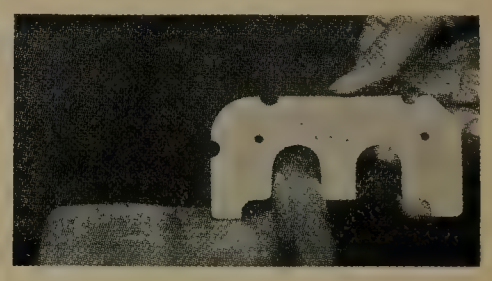


Fig. 11.

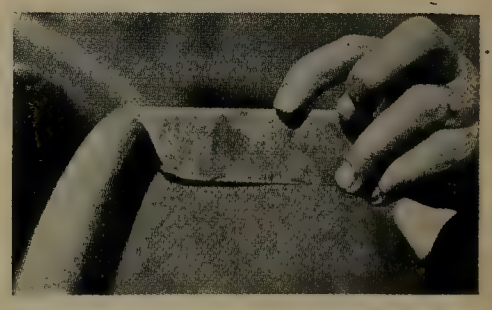


Fig. 12.

the gauge line, the wheel is unsafe for service and should be removed. Wheels having chipped flanges are not replaced by the manufacturer unless the chill is over one inch deep; thus indicating that the metal is too hard, and, consequently, brittle. Wheels removed on account of chipped flanges are, therefore, broken for examination to determine the depth of the chill.

Sharp flanges are caused by wear of wheels in service. Mismated wheels, wheels mounted too far apart or not equally distant from the middle of the axle, or wheels mounted on trucks that are out of line; that is, out of square, cause excessive flange wear. A sharp flange in itself will not necessarily cause derailment, but in connection with some other defect, such as a faulty switch point or a defective frog, may cause serious results. There is also the danger of the flange breaking, when it becomes too thin. Therefore, sharp flanges may be

Fig. 13.

Fig. 14.

considered as one of the most serious defects in wheels that occur in service. Sharp flanges are readily discernible, and should be carefully watched, and tested by the M. C. B. gauge.

Figs. 10 and 11 show cases of a sharp flange, also methods of testing for sharp flanges with the M. C. B. gauge; the wheels illustrated being beyond the prescribed limit. (Fig. 12 illustrates the method of gauging for worn treads.)

A crack of any kind in a wheel, with the exception of small cracks in the tread of a wheel on a spot where brake burning has occurred, or where small slid flat places appear, is sufficient cause to warrant removal of the wheel from service. This includes cracks in the tread, plate, bracket, flange, throat, hub, or anywhere else on the wheel.

The discovery of a wheel that is loose on the axle naturally calls for its immediate removal. Such a condition, however, is seldom discovered by inspectors. It is usually only evident when the wheels are being removed from the axle in the press.

Wheels may require removal for unusual causes, such as being damaged in a wreck or being in a fire, and thus becoming warped, cracked, or blistered on the tread. It might be well to call attention to the fact that where wheels begin to show badly seamed and rotten rims—that is, where there is evidence of deterioration of the material—inspection of the date when wheel was cast will usually indicate that the wheel is approximately twelve years old. While there are no instructions to this effect, inspectors are justified in removing such wheels if the flanges are at all close to the sharp flange limit, when in their judgment the appearance of the wheel, particularly the appearance of the rim, indicates a weakened condition of the metal that might produce a failure.

Fig. 13 shows cracks in a steel wheel due to brake burns and Fig. 14 shows a wheel shelled or seamy, perhaps from brake burning. Figs. 15 and 16 show shell outs. It can be noticed in this connection, however, that shell outs on steel wheels differ in their nature from those on cast-iron wheels; the shell outs in steel wheels being laminated in structure, in other words, the metal appears to have been built up in thin layers instead of being one solid piece.

LOW-WATER TESTS AND THEIR RESULTS.*

One of the principal advantages claimed for the Jacobs-Shupert boiler is that of increased safety. This claim has been based upon the fact that its firebox is made up of comparatively small sections, that the rivets joining the sections are entirely in the water space of the boiler, where even under low-water conditions they can not be exposed to the direct action of the heat, and that there are no stays in side-sheets or crown ending in the firebox. If low water occurs and the crown-sheet becomes overheated, the parts most affected are the curved portions making up the center of the sections, that is, the portions of the plates most remote from the joints. The excessive heating, therefore, comes at a point which, by the design of the boiler, is best able to withstand it. It is, of course, entirely conceivable that even under these conditions the overheating may proceed to a point which will result in a failure of the sheet, but it has been claimed that even in such an event, a single section only will fail, that the plate will pocket and blow out

*An unofficial report of this test with illustrations, was published in the Railway Master Mechanic, issue of July, 1912.

Fig. 15.

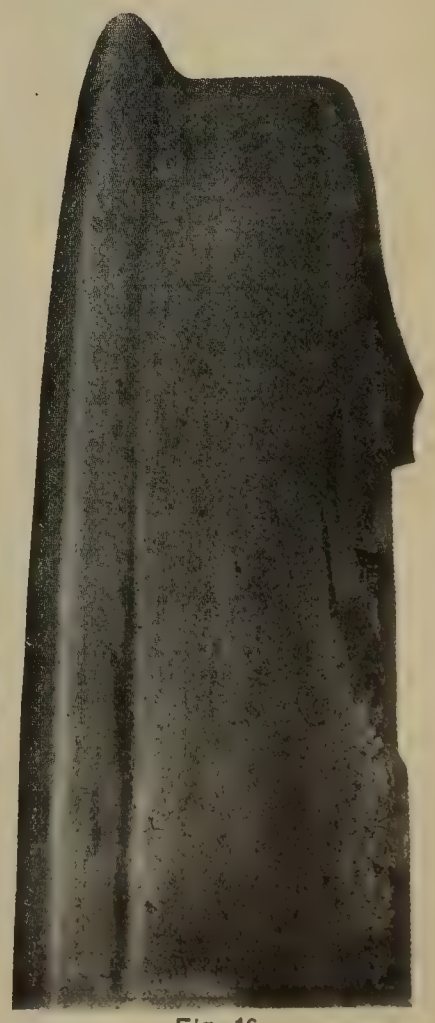


Fig. 16.

through a comparatively small opening, and that the effect of the failure will be entirely local. These assumptions, if true, make the Jacobs-Shupert boiler a safety-boiler in the same sense that the modern water-tube boiler, so much used in stationary service, is a safety-boiler. If the action described actually takes place, there can be no explosions of a Jacobs-Shupert boiler such as occur in the case of a radial-stay boiler when the crown-sheet comes down. The confidence with which the claims for safety were put forth had been greatly strengthened by the results of a test of a large Jacobs-Shupert boiler which was made at Topeka, Kansas, in the fall of 1910. These tests were most carefully conducted by Mr. H. B. MacFarland, and the results as reported by him completely sustain the assumption above stated. But notwithstanding the confirmatory evidence thus supplied, the officers of the Jacobs-Shupert company early expressed the desire that such tests be included in the series to be conducted by the undersigned, and these were, as a consequence, specified in the original outline. This provided that at the conclusion of the evaporative tests, the results of which have already been presented, both the Jacobs-Shupert boiler and

View of Radial Stay Boiler After Explosion.

the radial-stay boiler should be tested to complete failure under low-water conditions if that should be practicable.

The boilers were the same as those used in the previous tests. Both were of the same general dimensions, and both were designed for a working pressure of 225 pounds. As has been previously stated, the firebox-end of the Jacobs-Shupert boiler was selected at random from a number of similar fireboxes under construction at Coatesville on the order of a railroad company. There was nothing special about it. It was, however, fitted up under the scrutiny of a personal representative of the writer. It was no stronger or better than the others of the same lot.

The radial-stay boiler was constructed under the specifications of the Santa Fe Railway by the Baldwin Locomotive Works under the scrutiny of a Santa Fe inspector.

Preparations for the low-water tests received careful attention. An extensive fill made up of refuse from the mill of the Lukens Iron & Steel Company, extending up the valley of a small stream for a distance of several thousand feet, remote from habitations, supplied an acceptable grounds. Each boiler was set on two concrete piers, one under the firebox approximately 10 feet square, and the other under the barrel of the boiler of much smaller dimensions. A substantial shelter for those conducting the tests, consisting principally of the firebox-end of a Jacobs-Shupert boiler, was established 200 feet from the nearest boiler. In the rear of this shelter an oil-tank was erected at such a height as would serve to deliver fuel-oil to the burners under the boilers by gravity, and a small pump near the tank served to take oil from a works tank-car which could be switched to an adjacent track to this service tank. The boilers were fed with water by means of an independent steam-pumping plant located on the bank of the stream below the fill. A shelter was provided for the attendant of this plant. A main feed line was laid directly from the feed pump to the operators' shelter, at which point it branched to each boiler, a valve in each branch within the shelter permitting a control of the feed during the progress of the tests. The oil-supply pipe also branched at the shelter, and each branch was provided with valves permitting control at that point. These oil-valves, however, were not used except to shut off the supply of oil when the boiler being supplied went out of commision. The draft which during the low-water tests was supplied in the same manner as in the evaporative tests, that is, by discharging steam from the boiler through a normal exhaust pipe and tip, could be controlled from the shelter. This was accomplished by having a ratchet-wheel fitted to the stem of the 7-inch valve in the steam-delivery pipe, and two levers carrying dogs to engage the ratchet-wheel. The action of one lever served to open the valve, while that of the other closed it. Either lever could be operated by pulling a wire at the shelter, a counterweight serving to return the lever to its initial position. It had been planned originally to observe the steam pressure and water-level by means of water-glasses and gages located within the shelter, but the possibility of errors appearing in apparatus extended so far from the boilers resulted in a determination to take these readings from apparatus immediately affixed to the boiler. To make this possible two small telescopes were mounted on the top of the operating shelter, by the use of which observers could read with greatest ease the graduations and figures on the steam-gage, and observe accurately the level of the water in the water-glass.

The Jacobs-Shupert boiler, the first to be tested, was brought under conditions which had been carefully predetermined. The valve controlling the discharge of steam from the exhaust tip was carefully adjusted until the draft-gage connecting with the front-end indicated 6 inches of water. The oil supplied the fire was next adjusted to give as heavy a fire as could be sustained by this draft without black smoke. Preliminary tests had shown that this condition of draft and fire with the boiler in question could be relied upon to evaporate approximately 30,000 pounds of water per hour, or 10 pounds of water per foot of heating-surface per hour. This condition is not the maximum to which the boiler could be forced, but was accepted as representing that which under road conditions would be regarded as a heavy normal load. Upon the report from the attendants that the predetermined conditions had been secured, a committee of three engineers consisting of Charles Ducas, J. F. Butler, and P. C. Haldeman were requested to inspect carefully the boiler as it was then operating and to report to the undersigned whether all conditions were in accordance with the program. After eight or ten minutes this committee returned to the shelter, reporting that all conditions, including the draft, the fire, the water-level, the steam pressure, etc., were as stated, whereupon it was announced from the shelter that the tests would begin.

The organization at the shelter was as follows:

Charles Ducas. Time-keeper. It was Mr. Ducas' part to call out a warning and to give a signal at 30-second intervals. Mr. Ducas also made the necessary changes in the display boards, which served to indicate to the guests the condition of steam pressure and water-level after each observation.

J. F. Butler. Observer of water-levels and checker of steam-gage readings at Telescope A.

P. C. Haldeman. Observer of gage readings and checker of water-levels at Telescope B.

A. M. Baird. Assistant in immediate charge of boiler operation.

H. S. Coleman. Log keeper.

W. Seachrist. Valve operator within the shelter.

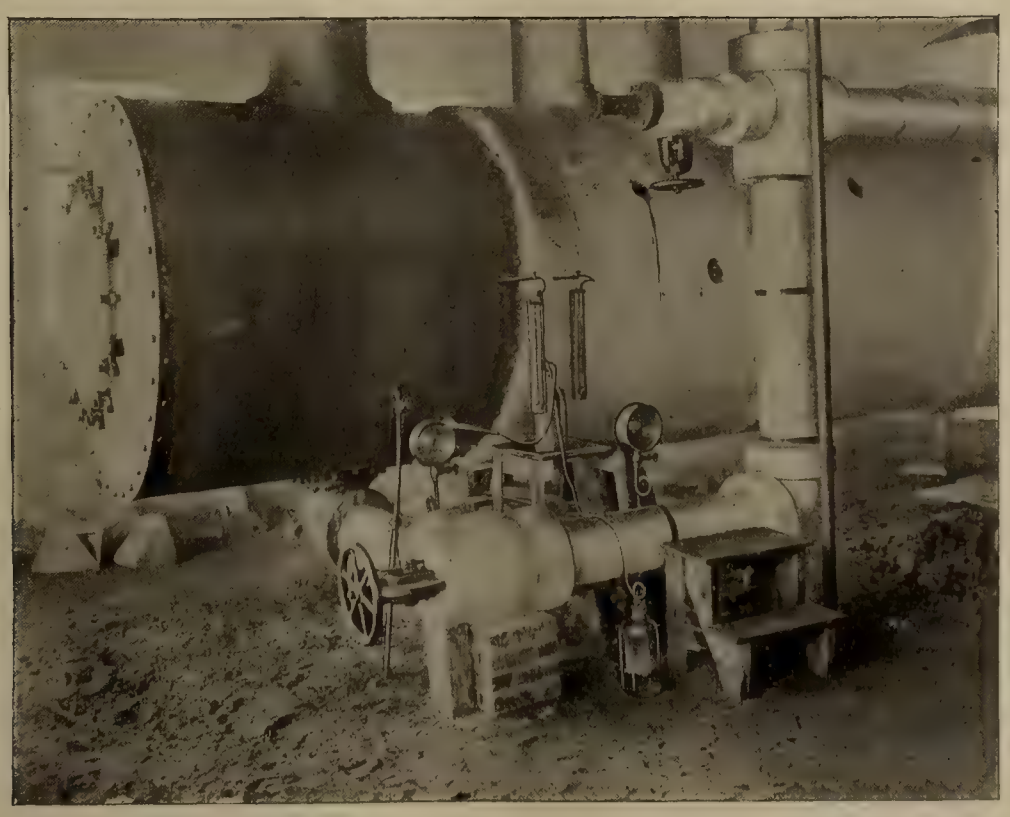
W. F. M. Goss. Expert in charge.

The test of the Jacobs-Shupert boiler began at 1:48 p. m. Upon signal from the time-keeper, observations were reported and noted upon the log in the following order:

(a) Water-level
(b) Steam pressure
(c) Number of pops blowing.

After these entries were complete, the check readings were announced. By observing this order of procedure there was never confusion, though the time interval between observations was short. The expert in charge had before him a plotted diagram with the 30-second intervals marked off as abscissae, and upon which he noted the water-levels as ordinates so that the history of the tests at any particular moment was completely under his eye. All changes in the setting of valves was in response to verbal direction from the expert in charge. The procedure thus described was persisted in without interruption until the test was terminated. The water left the crown-sheet at 1:49 1-6 p. m., and its level steadily declined for 34 1-6 minutes when it had fallen to the bottom of the special water-glass 25½ inches below the crown-sheet. The steaming capacity of the boiler declined as the water-level fell. In the beginning, besides the steam passing out of the exhaust pipe, a large volume was discharged by the safety-valves, but with the fall of water-level the amounts thus discharged diminished until the valves ceased to open. The pressure then declined, the blast became less effective, the draft weakened, and the fire became smoky. Twice the throttle opening was increased to stimulate the draft, but the pressure ran down the more rapidly. Fifty-five minutes after the beginning of the test upon the Jacobs-Shupert boiler, the water-level had fallen to a point where the barrel of the boiler was less than one-fourth filled, and the capacity of the boiler to generate steam had so diminished that the draft conditions with which the test started could no longer be maintained. The oil supply had not been changed and an enormous cloud of black smoke issued from the stack. When the steam pressure had fallen to 50 pounds, the low-water test of the Jacobs-Shupert boiler was ended. It had been boiled nearly dry and no failure had occurred.

Immediately upon the termination of the test of the Jacobs Shubert Boiler, fire was restarted under the radial-stay boiler. Approximately half an hour was required in which to bring this boiler to a condition of operation identical with

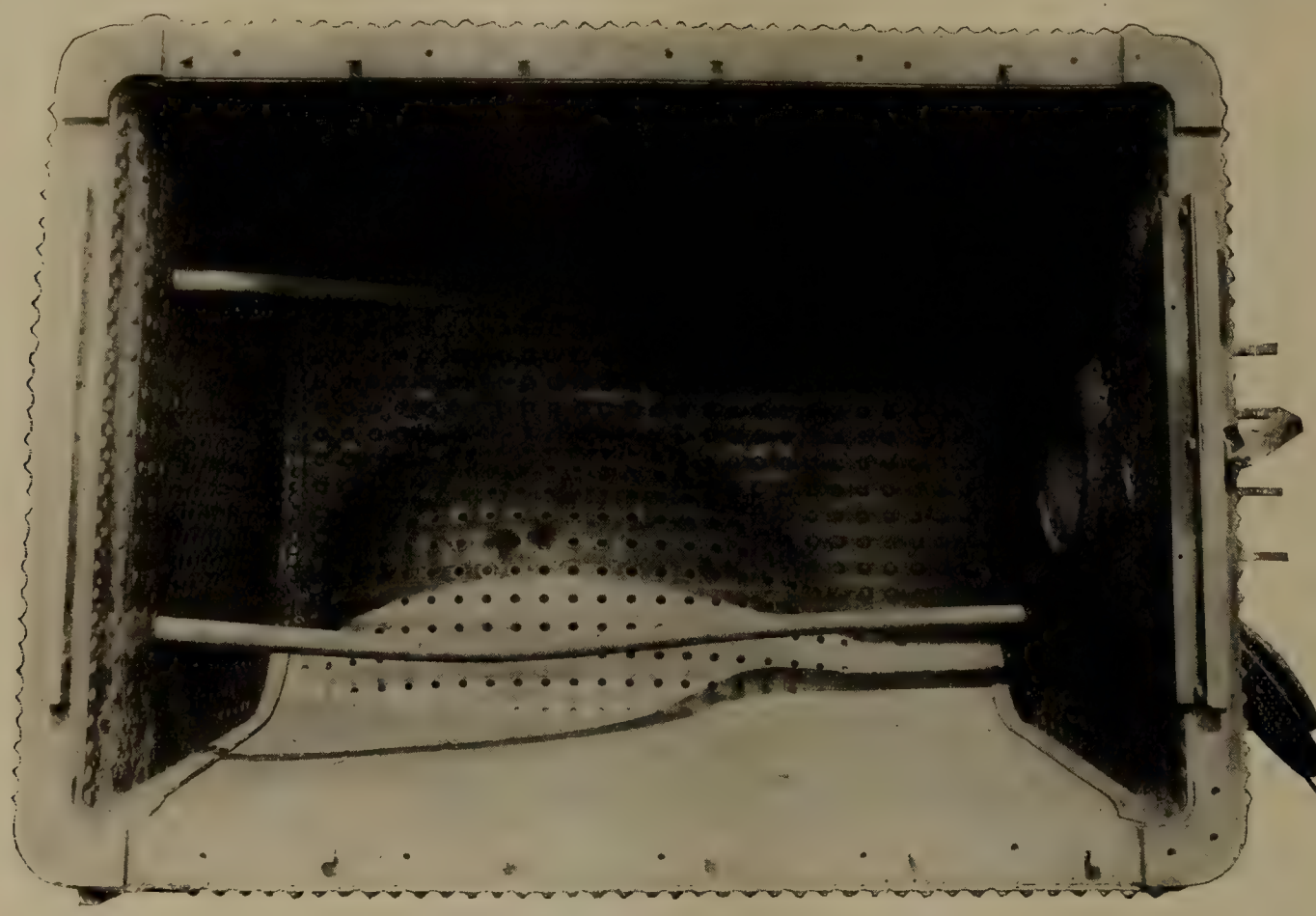


View Showing Draft Gages, Gas Samplers and Steam Gages.

that which defined the operation of the Jacobs-Shupert boiler. The conditions when secured were announced, the test was started, and the record kept in precisely the same way as had been previously done. When the water had fallen in the water-glass to a point which was 14½ inches below the crown-sheet, 17¾ minutes after the water had fallen to the level of the crown-sheet, the spectators heard above the steady roar of the exhaust a loud report and saw a great cloud of steam, rolling out in all directions from the neighborhood of the mud-ring, quickly envelop the entire boiler and its immediate surroundings. Every one understood that the test of the radial-stay boiler under low-water conditions was over and that the boiler had failed.

A detailed study of the tests supplies a more accurate definition of what occurred. Prior to the beginning of the tests, a tentative curve showing a proposed rate at which the water-level should be allowed to decline was drawn, and an attempt to parallel this curve in the actual test led to the feeding of both boilers for brief intervals in the early part of the test. It soon became apparent, however, that the actual curve would run above the assumed curve, and consequently no feeding was employed except in the early part of the test. In the Jacobs-Shupert boiler the feed was on for a total of 2½ minutes during the first 5 minutes of the test, after which the whole process was simply one of boiling away the water contained by the boiler. In the radial-stay boiler the feed was on 2 minutes during the first 7 minutes of the test only. The fall of the water-level in both boilers is shown graphically by Fig. 9. In the execution of the tests, the main purpose was to secure a rate of fall in the water-level which should be substantially the same for both boilers. Both boilers lost water at substantially the same rate for the first 22½ minutes of the test. At the end of this time, the radial-stay boiler had failed, but the Jacobs-Shupert boiler continued in operation without diminution in the amount of oil burned for 30½ minutes longer. The radial-stay boiler failed in less than 18 minutes after the water was observed at the crown-sheet level. The Jacobs-Shupert boiler was operated 53 minutes after the water was observed at the crown-sheet level.

Many of those who witnessed the tests received the impression that the Jacobs-Shupert boiler did not steam as freely as the radial-stay boiler. Two causes operated to give rise to such an impression: First, it is true that during the first 6 minutes of the test of the Jacobs-Shupert boiler, the excess of steam generated over that required to produce the draft was successfully discharged by two safety-valves, whereas throughout the corresponding period the three safety-valves of the radial-stay boiler were always open. An explanation of this action is to be found in the fact that the Jacobs-Shupert boiler was not so well supplied with water at the start, and as shown by the record was fed liberally during the first few minutes of the test. Second, another condition which influenced the spectator grew out of the fact that the test of the Jacobs-Shupert boiler endured for 32½ minutes longer than that of the radial-stay boiler. The spectator was naturally more impressed by the conditions prevailing during the last half hour of the test than by those prevailing during the earlier portions thereof. He knew that the water-level was steadily receding, failure seemed imminent, and he was in the attitude of expectancy. His condition of mind and the fact that during this interval the quantity of steam discharged steadily declined, accounts for the impression referred to. Such an impression so far as it has reference to that portion of the test of the Jacobs-Shupert boiler which is comparable with the entire period of endurance of the radial-stay boiler finds no justification in the records of the tests.



Interior of Radial Stay Boiler After Low Water Test.

The fact that after nearly a half hour of operation without feed, the delivery of steam from the Jacobs-Shupert boiler diminished as the test proceeded is to be accounted for in several ways: First, as the heating-surface of the boiler became bared, its evaporative capacity necessarily diminished; second, with heating-surface bare, the steam delivered became superheated and the safety-valves were called upon to handle a reduced weight o fsteam, each pound of which carried away an increasing amount of heat; third, as the heating-surface became bare, the heat of the furnace was in part absorbed in raising the temperature of the metal of the boiler, not only the firebox and the tubes, but in-

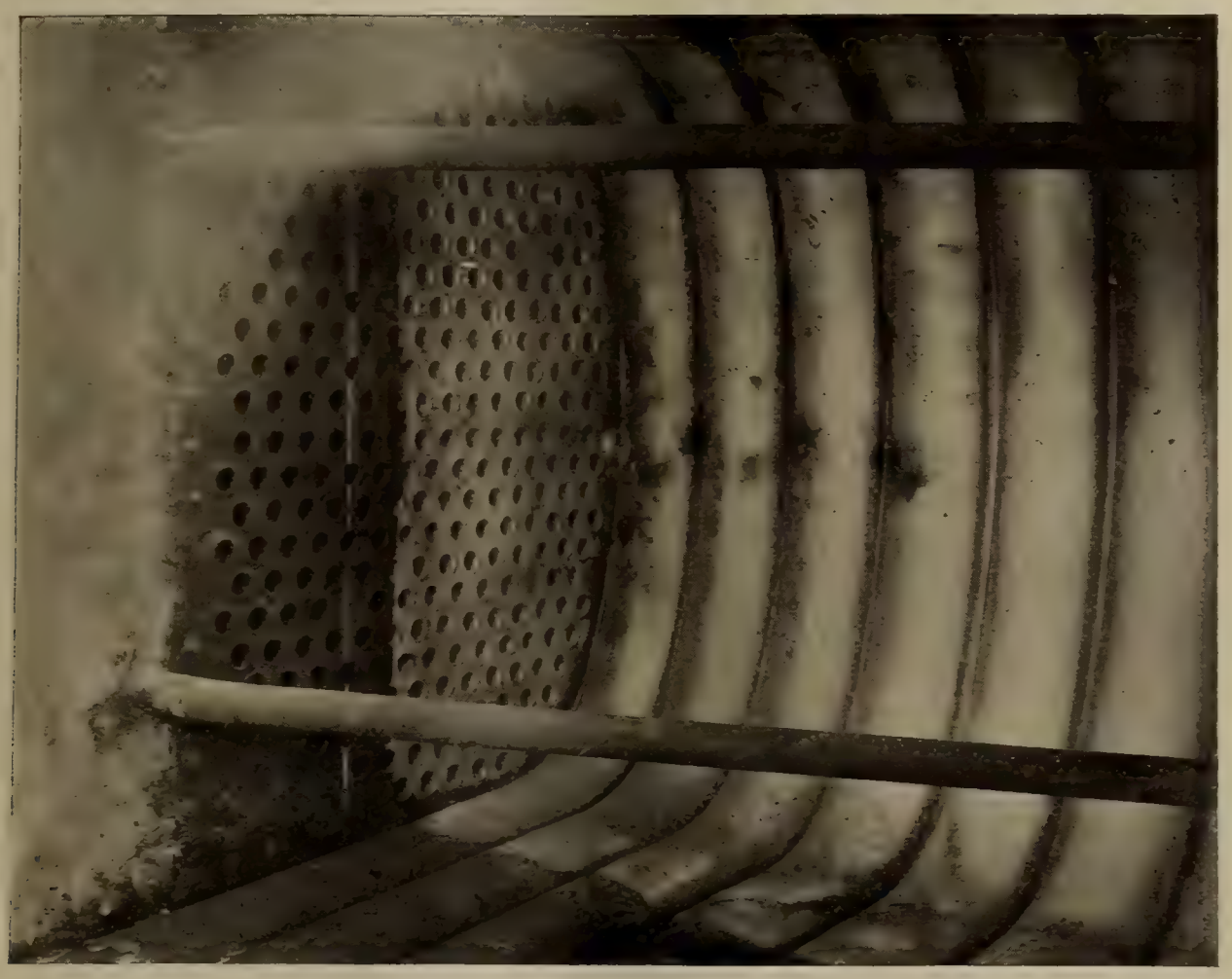
directly through the increased temperature of the steam within the boiler, the shell, and all parts to which the steam had access. Heat could not be taken from the firebox to raise the temperature of the steam and to increase the temperature of metallic parts of the boiler and at the same time evaporate as much water as was possible before these new avenues of heat absorption appeared. The working out of this process and the fact that the test of the Jacobs-Shupert boiler proceeded until 78 per cent of the water it contained had been evaporated, explains the significance of the observed action.

As already stated, it was the purpose in the case of each boiler to start under conditions which would insure the evaporation of approximately 10 pounds of water per foot of heating-surface per hour. This is equivalent to a total of 30,000 pounds per hour. It has just been shown that at whatever rate the boilers may have been started, the output in the form of water evaporated must have steadily declined as the test proceeded. It would be interesting to know what was the rate of this decline. Data for such an inquiry are supplied by the known weight of water contained by the boiler for every surface-level and the observed rate at which the surface-level receded. An attempt to make use of these data leads to inconsistencies resulting, no doubt, from unavoidable errors in observation caused by the surging of the water in the gage-glass. But however inaccurate, the results of such an investigation are not without interest, and brief reference may therefore be made to them.

Concerning rate of evaporation, Jacobs-Shupert boiler:

Five-Minute Intervals.	Pounds of Water Equivalent to Drop in Water Level for Five-Minute Intervals.	Pounds of Water per Hour.	Minutes During Which Feed Valve to Boiler Was Open.
1:48 to 1:53	1,300	15,600	2.5
1:53 to 1:58	2,000	24,000	0.0
1:58 to 2:03	875	10,500	0.0
2:03 to 2:08	2,825	33,900	0.0
2:08 to 2:13	1,700	20,400	0.0
2:13 to 2:18	1,875	22,500	0.0
2:18 to 2:23	1,325	15,900	0.0

The boiler feed-valve was open during one-half of the first interval embraced by those computations. The weight of water, fed, if it were known, should be added to the value given in the second column. It is known that the rate of feed more than equaled the rate of evaporation so that the actual rate of evaporation during this interval must have been more than double 15,600 pounds. At 2:23.5 the water passed below the bottom of the gage-glass which was 25.5 inches below the crown-sheet. The calibration curve shows that there was then a little more than 10,000 pounds of water in the boiler, which when filled to the middle gage-cock, contains 30,000 pounds.



Forward Portion of Jacobs-Shubert Firebox After Test.

Concerning rate of evaporation, radial-stay boiler:

Five-Minute Intervals.	Pounds of Water Equivalent to Drop in Water Level for Five-Minute Intervals.	Pounds of Water per Hour.	Minutes During Which Feed Valve to Boiler Was Open.
3:35 to 3:40	1,600	19,200	1.0
3:40 to 3:45	1,800	21,600	1.0
3:45 to 3:50	1,800	21,600	0.0
3:50 to 3:55	2,200	26,400	0.0

It will be seen that the values deduced for the first two intervals are affected by the introduction of feed-water. The weight of water fed should, of course, be added to the value in the second column. At 3.57¾ the boiler failed. It contained at the time of failure something more than 14,000 pounds of water.

still sufficiently heated to glow. A description of a detailed

The conclusion of the low-water test as applied to the Jacobs-Shupert boiler found that boiler undisturbed and apparently ready for service. After having boiled nearly dry, when its steam pressure had fallen to 50 pounds, the test was determined by shutting off the blast and the fuel supply. An hour later, after the test of the radial-stay boiler had been completed, an inspection, through the door of the Jacobs-Shupert boiler, disclosed portions of the brick arch inspection of this boiler which was made later is as follows:

The Jacobs-Shubert fire box was found to be wholly undisturbed and in perfect condition. Later, this arch was re-

Close View of Pocket Formed in Crown Sheet of Radial Stay Boiler.

moved and the boiler turned on its side to facilitate inspection. A well-defined line of demarcation was found to run around the firebox approximately 34 inches below the stay-sheet calking line in the crown of the firebox. The line presented waves as it passed the convolutions of the several sections. Portions of the sections below this line were soot covered and normal in appearance. Higher up and in more exposed portions of the firebox the sections had the color a belt approximately 5 inches in width which was generally and appearance of freshly heated steel. The more highly heated portions were flecked with scales, resulting from oxidation. Between the portions which were soot covered and those which bore the appearance of freshly heated steel was reddish brown in color shading off into the black which was below and into the freshly heated steel above.

The firebox was made up of eleven sections. A critical examination of these, taking them in order beginning with the forward section, resulted as follows: The first section was found to show the color of newly heated steel on the curved portion, the effect being most striking on the lower side. This color did not anywhere extend entirely around to the stay sheet. A few scales of oxidation only were found on this section. The five successive sections were found to be similar except that each succeeding section bore evidence of increased heating effects. The hottest sections in the whole boiler were five and six, and these sections, as well as section seven, gave evidence of having been highly heated on the sides as well as in the crown. Sections five and six were thickly covered with scale. Section eight was found to have only a portion of its area the color of newly heated steel, and sections nine, ten, and eleven were found to be, within the heated zone, entirely of the reddish brown color.

Those most affected disclosed a curvature which drops one-half inch more than that which was originall given them. The change in contour, while not entirely regular, disclosed

Showing Pocket in Radial Stay Boiler After Low Water Test.

no evidence of a disposition to develop pockets or to local failure by blowing out. The final contours of the section were accurately outlined by means of templets made from the sheets. It is noteworthy that, notwithstanding the high temperature to which this firebox was subjected, the color of newly heated metal nowhere extends around the section to a stay-sheet, nor was there any point on the calking edge of the stay-sheet which had been heated beyond that temperature which results in the reddish brown color. Nothing in the appearance of the sections or of the stay-sheets indicated the presence of the least leak through the crown.

The back tube-sheet was found to disclose a clearly defined water-line, which is 31¼ inches below the crown. The color of the greater portion of the area of this sheet is that of freshly heated metal. For two or three inches above the clearly defined water-line and for six or more inches around the edges of the sheet it was reddish brown. The tube-sheet was found to retain very nearly its original shape. On either side of the center and near the middle of the heated zone, where in the design of the boiler there is a considerable area unsupported by tubes, the plate was bulged to the extent of one-fourth inch. At the crown of the tube-sheet a small leak had developed. The joint at this point is made by riveting the first section of the firebox to the tube-sheet with a copper calking strip between. It is at the crown of this joint that the evidence of leak appears. This leak, the only one to be found in the firebox, was slight. It could not have interfered with the normal operation of the boiler.

Within the highly heated area of the tube-sheet are 188 tubes. Naturally the upper tubes were most affected by the heat to which they were exposed. Four of the tubes were found to have collapsed just inside of the tube-sheet, 14 others, making 18 altogether, were found pulled apart inside of the sheet. The weld between the tube and the sheet was not disturbed in any case. It is probable that, except in the case of those which collapsed, the actual rupture of these various tubes occurred in the process of cooling after the test had been finished. All other tubes were intact so far as their contact with the back tube-sheet is concerned. All those within the heated zone were found deflected downward, the deflection varying from a comparatively small amount to an amount equal to the diameter of the tubes. The tubes which at the conclusion of the test were below the water-line remained in their original straight condition.

The door-sheet of the firebox was not greatly affected by the conditions imposed by the test. No distinctly marked water-line appears upon this sheet, though the upper portion had the mottled reddish brown and black appearance. There was no distortion of this sheet and no evidence of leaking stay-bolts.

The arch tubes were not disturbed or affected by the test, and the arch at the conclusion of the test was, as already noted, in perfect condition. The mottled appearance of the arch tubes in some of the photographs results from a disturbance of the soot which covered them.

A review of these conditions discloses the fact that so far as the firebox construction is concerned, the boiler at the conclusion of the test was in condition for operation.

The radial-stay boiler failed under the low-water test. The force of the explosion was sufficient to raise the rear of the boiler, to blow out the tile brick arch, to blow out the cast-iron pedestals, to disrupt the brickwork under the boiler, and to scatter fragments of all of these over an area a hundred feet or more in radius. The boiler itself was lifted from its foundation and was moved forward a distance of about 8 inches, the rear swinging to the right. As the front end of the boiler slid forward on the support under the barrel, an extra heavy blow-off pipe was sheared.

The radial-stay boiler failed by the pocketing of a considerable section of the crown of the boiler. This section embraces 188 crown-stays and stay-bolts. The button-headed stays failed by the stays breaking inside of the sheet and the flat-headed stays pulled through the sheet. The length of the damaged portion as measured longitudinally extends from the first row of stays, counting from the front end of the firebox to the twenty-first row. In the first row the sheet pulled away from a single stay and in the twenty-first row from three stays. The sheet itself was found not to have ruptured or cracked, and, so far as could be determined, no button-headed stay pulled through the sheet, though the holes in the sheet are in many cases considerably elongated in direction of the maximum movement of the plate. The contents of the boiler were discharged through the openings vacated by the stay-bolts, the aggregate area of which has been found to be approximately 186 square inches.

A considerable portion of the undisturbed area of the crown of the firebox was found to be mottled blue and black, giving evidence of some scaling from the effects of heat. The brightness of the color, however, had been affected by the discharge of steam from the firebox. The button heads of the undisturbed stays in the vicinity of the pocketed section showed the same variegated blue, black and white. This effect, however, was practically confined to the zone occupied by the button-headed rivets and to the forward two-thirds of that zone. There was a slight change in the superficial color of the plate between the eighth and ninth row of stays on the left-hand side of the boiler, suggesting that below the ninth row of stays the effect of overheating was nil.

Both side-sheets with their staying were in perfect condition, no evidence of leaking stay-bolts appearing.

The door-sheet with its stays was found in perfect condition.

The tube-sheet was found in perfect form and the tubes appeared to be as secure as when originally welded thereto. Only a few tubes, variously estimated from nine to eighteen in number, seemed from their color to have been involved by the overheating. No tube was found which had been sufficiently heated to sag.

The arch tubes had been forced somewhat downward by the discharge of steam from the crown-sheet, and the right-hand tube had been distorted sufficiently to develop a leak in the tube-sheet.

The simple character of the failure of the radial-stay boiler permits our interest in the design and in the characteristics of the materials used in working out the design to be centered upon two things. These are the crown-sheet and the radial stays. The crown-sheet was manufactured by the Lukens Iron & Steel Company. A sample for test cut from this sheet and examined prior to the construction of the boiler gave the following characteristics:

Mark	N 1957
Ultimate strength, pounds per square inch	56,970
Elongation, per cent	25.00
Carbon, per cent	.16
Manganese, per cent	.42
Phosphorus, per cent	.02
Sulphur, per cent	.024

The fact that this sheet in coming down did not crack is in itself evidence of the high quality of the material.

These statements will suffice to show that in the selection of materials and in working out the construction, the radial-stay boiler was not inferior to the highest standards prevailing in such matters. The fact that the failure of the boiler was not more disastrous is to be accounted for in the superior character of the materials and workmanship employed in its construction.

The preceding description of the breaking down of the radial-stay firebox is significant in that it confirms the ex-

perience in practice on the road. The firebox tested was new; there was no accumulation of scale upon it. It had not been weakened by strains induced by long service, and it had every chance to present the maximum resistance to failure to be expected of that type of construction which it represents. The facts show, however, that when, through the receding of the water-level, the heated zone had extended downward sufficiently to include the upper portion of the crown and to take in only the upper rows of the tubes, this firebox, new and in perfect condition, possessing material advantage over the average radial-stay firebox in service, failed.

Personals

F. C. Hamilton has been appointed general foreman of the Atchison, Topeka & Santa Fe at Argentine, Kan.

G. A. Mann has been appointed storekeeper of the Santa Fe Coast Lines, with office at Barstow, Cal.

Chas. Johnson has been appointed foreman of the Santa Fe Coast Lines at Seligman, Ariz.

David Hopkins has been appointed road foreman of the Santa Fe Coast Lines with office at Fresno, Cal.

J. C. Love has been appointed road foreman of the Santa Fe Coast Line at San Bernardino, Cal.

C. McConley has been appointed road foreman of the Santa Fe Coast Lines at Albuquerque, N. M.

W. H. Connor has been appointed storekeeper of the Baltimore & Ohio at Painesville, Ohio.

J. Payne has been appointed storekeeper of the Baltimore & Ohio at Newark, Ohio.

A. E. McMillan has been appointed general foreman of the Baltimore & Ohio South Western at Cincinnati, succeeding G. A. Bowers.

F. Ramstead has been appointed storekeeper of the Canadian Northern at Prince Albert, Sask.

W. H. Wonderlee has been appointed foreman of locomotive repairs of the Chicago & Alton at Bloomington, Ill. He succeeds W. V. Brooks.

E. N. Brown has been appointed superintendent of the Chicago & Eastern Illinois with office at Danville, Ill.

G. E. Hendricks has been appointed general foreman of the Chicago & Eastern Illinois at Mitchell, Ind.

J. A. Burchill has been appointed foreman of shops of the Chicago & North Westestern at Waseca, Minn.

S. W. Mullinix, mechanical superintendent of the Chicago, Rock Island & Pacific at Topeka, has been appointed superintendent of shops at Silvis, Ill., succeeding G. W. Seidel, resigned to go with another road.

C. M. Taylor, mechanical superintendent of the Chicago, Rock Island & Pacific at El Reno, Okla., has been transferred to Topeka, Kan., succeeding S. W. Mullinix.

L. A. Richardson has been appointed mechanical superintendent of the Chicago, Rock Island & Pacific at El Reno. Mr. Richardson was formerly master mechanic at Chicago.

R. L. Stewart, master mechanic of the Chicago, Rock Island & Pacific, has been transferred from Trenton, Mo., to Chicago, where he will have jurisdiction over the Chicago Terminal and the Illinois divisions. He succeeds L. A. Richardson, promoted.

E. J. Harris, master mechanic of the Chicago, Rock Island & Pacific, has been transferred from Armourdale, Kan., to Trenton, Mo., succeeding R. L. Stewart.

J. C. Rhodes has been appointed master mechanic of the Chicago, Rock Island & Pacific at Estherville, Ia. He succeeds Frank Hopper.

Frank Hopper has been appointed master mechanic of the Duluth, Winnipeg & Pacific, with office at West Duluth, Minn. He was formerly master mechanic of the Rock Island at Estherville, Ia.

T. W. Callahan, formerly master mechanic of the Mesabi division of the Great Northern, has been appointed master mechanic of the Kalispell division, with office at Whitefish, Mont. He succeeds J. E. Delany, resigned.

John Lloyd has been appointed road foreman of engines of the Montana division of the Great Northern, vice George W. Webber, assigned to other duties.

F. W. Ramer, locomotive foreman of the Great Northern, has been transferred from Minot, N. D., to Glascow, Mont.

N. C. Bettenberg has been appointed master mechanic of the Great Northern, with office at Crookston, Minn. He succeeds J. W. Smith, transferred to Superior, Wis.

Wm. MacKenroth has been appointed locomotive foreman of the Great Northern at Minot, N. D. He succeeds F. W. Ramer.

L. H. Laden has been appointed car foreman of the Great Northern at Leavenworth, Wash.

C. A. Keller succeeds W. E. Rawson as general storekeeper of the Kansas City, Mexico & Orient, with office at Wichita, Kan.

M. A. Dow succeeds George Bradshaw as general safety agent of the New York Central Lines, with offices at New York and Chicago.

G. W. Seidel has been appointed superintendent of motive power of the Minneapolis & St. Louis, with office at Minneapolis. He succeeds C. E. Gossett, recently deceased.

W. L. Kellogg, formerly superintendent of machinery and equipment of the Missouri, Kansas & Texas at Parsons, Kan., has had his title changed to superintendent of motive power.

N. S. Airhart succeeds W. H. Brehm as master mechanic of the Missouri, Kansas & Texas at Parsons, Kan.

H. L. McLow has been appointed master mechanic of the Missouri, Kansas & Texas at Waco, Tex., succeeding J. H. Dougherty.

R. R. Bates succeeds W. F. Conavan as general foreman of the Missouri, Kansas & Texas. His office is at Parsons, Kan.

N. A. Alquist has been appointed general foreman car inspector of the Missouri, Kansas & Texas, with office at Parsons, Kan.

B. G. Horton has been appointed superintendent of locomotive fuel service on the New Orleans, Texas & Mexico, with office at De Quincy, La.

G. W. Keller has been appointed general foreman of the Norfolk & Western at Portsmouth, O. Mr. Keller served his apprenticeship on the Baltimore & Ohio and remained with this road seven years. In 1891 he went to the Norfolk & Western and has served this road in the capacities of roundhouse foreman, gang foreman, erecting shop foreman and general foreman.

Fred Hooker has been appointed superintendent of locomotive fuel service of the St. Louis, Brownsville & Mexico, with office at Kingsville, Tex.

O. Tefteller has been appointed superintendent of locomotive fuel service of the St. Louis, Brownsville & Mexico. His office is at Kingsville, Tex.

E. E. Dailey, assistant mechanical engineer of the Union Pacific at Omaha, Neb., has been appointed assistant to the director of purchases of the Southern Pacific, with office at New York.

W. E. Dewitt has been appointed road foreman of engines of the New York Central & Hudson River at East Buffalo, N. Y.

D. S. Littleholes has been appointed master mechanic of the Northern Pacific, with office at Jameston, N. D.

With The Manufacturers

DINING CAR VENTILATOR.

A recent improvement having to do with car ventilation which has met with widespread interest and proven a distinctive stride toward perfection is the new combination blower and exhaust ventilator illustrated in this article. The original intention of the inventor when designing the new ventilator was to overcome the difficulties which are experienced in securing proper ventilation for dining cars. The same type, however, with slight modifications, can be used to equal advantage in connection with the "Garland" system now in use on Pullmans and coaches.

The Garland exhaust type ventilator which was developed six years ago proves entirely adequate so long as the train is in motion but its functions cease with the stopping of the train. Consequently a sufficient amount of ventilation is not provided while the train is waiting in the station.

It is apparent that inadequate ventilating conditions should not exist in dining cars as the cooks begin operations two or three hours before the car is under motion and unless the car is equipped with blower ventilation, the air is soon filled with steam, smoke and obnoxious odors from the kitchen.

The accompanying design illustrates fairly well the construction of the combination blower and exhaust ventilator which is a very desirable supplement to the standard ventilator. It is somewhat difficult to represent diagramatically on account of its being made up largely of curved surfaces.

This ventilator which combines the action of the blower exhaust with that of the standard Garland ventilator, actually induces an added flow of air through the car, increasing the efficiency of the blower about 15 per cent. This is directly due to the action of the exhaust from the blower which is driven against the curved lip shown as a dotted line in figure 2 creating a whirling motion in the exhaust which draws the air out through the unrestricted openings of the Garland type ventilator.

Simultaneously with the starting of the train the regular Garland ventilator begins to perform its functions, increasing its action correspondingly with the increased speed of the train. Upon reaching normal speed of the generator equipment the motor of the blower is automatically cut off and the blower ceases operation. The ventilation is then effectually maintained by the Garland ventilators, which continue to operate until the train slows down at the next stop, when the automatic switch will again place the blower in operation until such time as the train has again attained sufficient headway to successfully operate the Garland ventilators.

The accompanying table of exhaust values shows that each blower ventilator unit alone in both kitchen and dining room exhausts 33,000 cubic feet of air per hour, a total of 66,000 cubic feet for the whole car. When the car is at rest this is sufficient to maintain a fairly good ventilation.

After the train attains a speed of 50 miles per hour the standard Garland ventilators will remove 140,000 cubic feet per hour from the dining room and 100,000 cubic feet from the kitchen, a total of 240,000 cubic feet per hour.

While the capacity of the kitchen is but 600 cubic feet and that of the dining room is 2,600 cubic feet, there are five exhaust ventilators in the kitchen against seven in the dining room. It naturally follows then that there will be a constant flow of air toward the kitchen, eliminating the possibility of the kitchen odors entering the dining room. To further decrease the possibility of a flow of air from the kitchen, the dining room blower ventilates from a decorative screen located in the arched panel directly over the passageway in front of the buffet. This ventilator not only draws the air from the car toward the kitchen, but catches any gases which might possibly escape the kitchen blower.

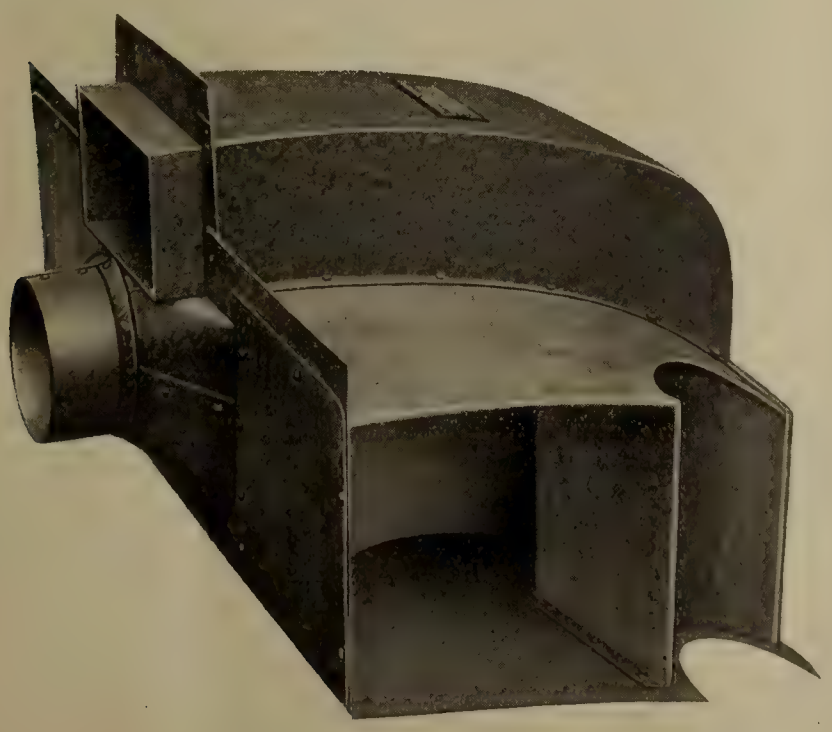


Fig. 1—Combination Garland Blower Ventilator.

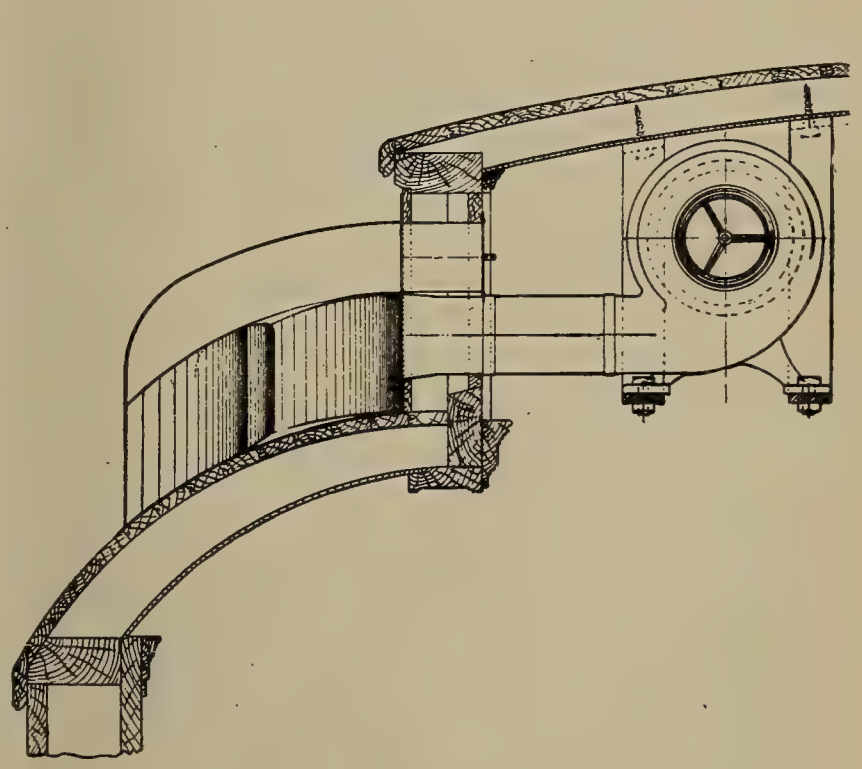


Fig. 2—Showing Position of Blower.

The blower employed in this unit is a special railway car ventilator blower manufactured by the B. F. Sturtevant & Co., and is designed so that the blower wheel can be taken out either through the air intake opening or by removing the motor; thumb screws being used which enables cooks to remove and clean the wheel without the use of tools.

The facility with which the blower wheel may be removed and cleaned is an important consideration for the exhaust passing through the blower is heavy laden with greasy steam and particles of carbonaceous matter, necessitating the frequent cleaning of the blower to insure satisfactory operation.

The results of tests are as follows:

Dining room equipped with 7 Standard Garland Exhaust Ventilators, train running.

Speed-Miles Per Hour	No. of Vents	Exhaust Cu. Ft. Per Hour	No. of times air changes per hour	Time in which air is completely changed
25	7	70,000	26.95	2.25 min.
30	7	84,000	32.25	1.86
40	7	105,000	40.38	1.48
50	7	140,000	53.85	1.11

Average air capacity of dining room is 2600 cubic feet.

Kitchen equipped with 5 Standard Garland Ventilators, train running.

Speed-Miles Per Hour	No. of Vents	Exhaust Cu. Ft. Per Hour	No. of times air changes per hour	Time in which air is completely changed
25	5	50,000	83.33	.72 min.
30	5	60,000	100.00	.6
40	5	75,000	125.00	.48
50	5	100,000	166.66	.36

Average air capacity of kitchen is 600 cubic feet.

Auxiliary Blower Alone.

	Cu. Ft. of air drawn out per hour	No. of times air changes per hour	Time in which air is completely changed
In Dining Room	33,000	12.7	4.7
In Kitchen	33,000	55.	1.09

ILLUMINATION OF THE NEW BURLINGTON BUILDING, CHICAGO.

The new office building of the Chicago, Burlington & Quincy R. R. in Chicago is fireproof throughout; the supporting columns are of structural steel protected against fire and corrosion by concrete and tile. The walls are of cream colored terra cotta and marble. It has a frontage of 151 feet on Jackson Boulevard, and 175 feet on Clinton Street. The total floor space in the building measures over 250,000 square feet. There are two sub-basements below the street level, the lower one of which serves to house an isolated plant which will furnish heat and power for the building. The plant consists of four 300 H. P. water tube boilers which furnish power for two 300 and one 150 kilowatt generators, power from which is sent out over three direct connected wires furnishing 110 and 220 volts. The generators are driven by direct connected low speed Corliss engines. The capacity of this plant is sufficient to take care of the lighting and power requirements for the entire structure, and is considered to be the most modern building plant in Chicago.

Not the least prgoressive of the various features which mark this building is the lighting. The lighting here has been made a feature laid out on careful and scientific lines with a greater stress on the comforts and efficiency of the employees. After a most careful consideration of fixtures extending over a period of several months and including a number of very unique tests, with the efficiency of the employee and the cost of maintenance always uppermost in their minds, the committee selected Alexalites, manufactured by the Central Electric Co., Chicago, as a medium through which artificial lighting was to be given in the various offices of the building.

The sources of light are entirely concealed and the fixture which acts as a diffuser is modest, attractive, and in harmony with the surroundings. Each is finished in a dull white with no shining parts of the fixture visible. The requirements as laid down by the building committee called for an initial intensity of 4½ ft. candles on a 30-inch plane for general office work; for drafting room purposes an initial intensity of 8 ft. candles on a forty inch plane, and for corridor lighting an initial intensity of 1½ ft. candle on thirty inch plane. To produce this effect 2,124 Alexalites were used. The average wattage consumption per square foot necessary to produce 4½ ft. candles is 1.17 watts per sq. ft. In drafting room in order to produce 8 ft. candles 2.2 watts per sq. ft. It is well to bear in mind that the walls are light cream colored, the ceiling is practically white.

A few facts here on the relation of light intensity and power consumption will be both interesting and instructive, since this installation is the first of its kind in this country. It is absolutely unique in that the plans for indirect lighting are followed throughout. In the general offices the ceilings are white and eleven feet high; the walls are buff in color. Alexalites were placed on twelve-foot centers, and with an initial consumption of 1.17 watts per square foot an intensity of 4.5 foot candles is produced. In the drafting room with two hundred and fifty watt units placed on ten-foot centers, with an average consumption of 2 watts per square foot, an intensity of eight and one-half-foot candles is produced.

The Alexalite is scientific in its construction. It is placed a specified distance from the ceiling. The diffuser basin was designed by one of the most efficient lighting engineers in this country. This basin is coated with a lasting fired porcelain enamel that will not deteriorate or change color. Its scientific shape permits the use of one lamp projecting down into the basin. The result is maximum diffused light.

NEW SAFETY LADDER FOR BOX CARS.

The "All-Steel Safety Ladder" was designed primarily to provide maximum safety for the train men and to facilitate bringing the ladder equipment of box and other high cars within the requirements of the United States Safety Appliance law.

All Steel Safety Ladder Applied to Car With Metal Roof.

This ladder has rungs riveted to stiles made from bar steel, and those parts on the car body are spaced to a convenient position by cast iron furring spools on the intermediate bolts. Spacing on top of the car roof is effected by bending the projecting stiles parallel with the roof, and by further bending the stile ends downward. The top construction differs somewhat for wood and metal roofs, but in other instances, the roof grab irons are a firm part of the main ladders and require no holes in the roof. On wooden roof cars, the stile ends of the side ladder bear squarely on the roof and one stile end of the end ladder is bolted to the side ladder stile, thus leaving no part on which trainmen would be apt to catch their feet or clothing. On metal-roofed cars, similar safety is effected by bolting the

side ladder stile ends to the brakeman's platform. The stiles of the side ladder both extend far enough upon the roof to provide for the required roof rung, while the endmost stile extends far enough to form a roof grab iron in connection with the end ladder, also to permit of end and side ladders being secured to each other.

All Steel Safety Ladder Applied to Car With Wooden Roof.

Maximum safety is claimed by the manufacturers because of the strong elements, the practically one-piece construction and the additional strength by the bends over the top of the car and the fastening of end and side ladders to each other. The stiles being bolted entirely through the side and end-plated bolt rails and the side sills on wooden cars, or sub-sills on cars with steel sub-frames, also help to make this ladder safer from accident than is the ordinary form where decaying of lighter timbers allows the bolts to pull out.

All-Steel Safety Ladders can be applied to existing box cars without having to tear out a portion of the siding and putting in special sub-framing, which effects saving over adding another set of grab irons of the old type. Solidity on the car roof is obtained without screws, clips or bolts piercing the roof in any way, hence the possibility of leakage onto the lading, and the decaying of roof parts is avoided.

The brakeman's platform is secured in a fixed position by bolting to the ladders only, hence shifting of the running board has no effect on a platform held in place by this ladder and no fastenings can break out and allow the platform to come off.

Where the safety ladder is used it is claimed that a safe and simplified platform can be made and installed at less than half the cost of an old type platform and its fastenings.

The All-Steel Safety Ladder is made by the Safety Steel Ladder Co., 810 Olive St., St. Louis, Mo.

BUFFALO JOURNAL BOX.

During the past five years the Pratt & Letchworth Co., Buffalo, N. Y., has developed the Buffalo malleable iron journal box which is now manufactured in all standard M. C. B. sizes, and is made from a grade of malleable iron which long experience has demonstrated to be best adapted to railway purposes.

It is the policy of this long established malleable iron plant to put on the market a journal box qualified to represent the high standard of workmanship and material for which the Pratt & Letchworth Company has always stood, and the unparalleled success of the 200,000 Buffalo journal boxes now in service on the leading eastern railways testifies that they have lived up to the high standard set for them.

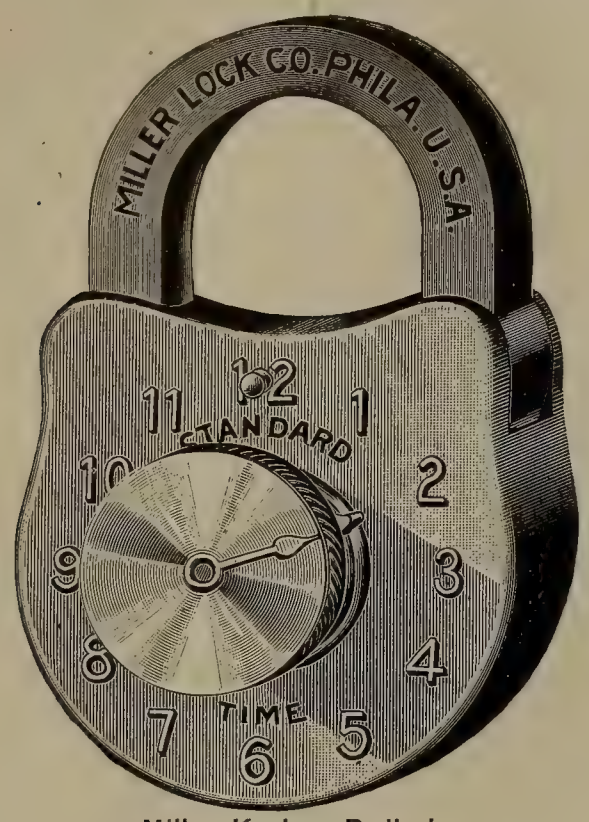
The Buffalo box contains two coil springs arranged in such a way as to be always under tension so that the lid, whether open or closed, is held firmly in position, preventing all wear from lateral vibration and taking up automatically any wear in the pin holes. The great advantage of this box is that the lid will close and lock automatically at whatever angle it may be left open. Since the lid remains in an open position

Buffalo Malleable Journal Box.

only on account of the friction of the cams against the follower, the weight of the overhanging lid causes it to close by the vibration of the car when in motion. In opening the box the leverage against the springs is so great that the lid lifts very easily. No special repair parts are required in connection with the Buffalo box because the face and hinge are absolutely interchangeable with M. C. B. lid and spring.

MILLER KEYLESS PADLOCK.

The Miller "Standard Time" lock No. 34, manufactured by the Miller Lock Co., of Philadelphia, is especially adaptable for lockers and general indoor purposes. It is made with a steel case black japanned or with brass case and shackle and all



Miller Keyless Padlock.

brass interior parts. It is positively non-pickable, and thousands of combinations, all different, can be furnished. It is so constructed that it can be operated in the dark as readily as in the light; is simple, secure and serviceable, rust and dust proof, and when attached to metal doors or lockers is guaranteed for a period of ten years against everything except fire and abuse. The advantages of keyless locks over keyed locks are obvious, as there are no keys to lose, break off in the lock or become duplicated by someone who may want access to a certain locker or closet.

THE ART OF CAR building has shaped a new feature in the last few years. All new cars being built have the best steel underframing and a perfect steel end is equally essential. The W. T. Van Dorn Co. of Chicago is offering to the railroads a design of steel end that has been thoroughly tested in train service on many of the leading roads and it has made a record worthy of careful attention. One reason that a steel end is more essential now than heretofore is that the railroads are called on to transport lumber of all kinds across the continent, which was never done in quantities until of late. The shifting of lumber in train service is causing great loss to the railroad companies by the breaking out of the ends. The Van Dorn one-piece steel ends, entirely eliminate this, for their concentric corrugated construction carries great strength.

New Literature

The Reliance Mfg. Co. of Massillon, O., has issued a folder descriptive of Reliance nut locks. These are made in many different types and sizes.

Bulletins 126 and 129 of the Chicago Pneumatic Tool Co., Chicago, Ill., are devoted respectively to hose, hose couplings and hose clamp tools, and compression riveters. The compression riveters may be used advantageously when the riveting to be done is more or less uniform and accessible and where it is to be done in large quantities.

* * *

"Dayton Sanitary Fixtures for Railway Cars," is the title of catalogue 160 of the Dayton Mfg. Co., Dayton, O. This firm manufactures a complete line of wet and dry closets, washstands and water coolers and they are carefully illustrated and described in their catalogue. This firm has also issued leaflets on the "Ardee" sash lock and anti-rattler; an improved sash lift and a steel sash spring for car windows.

* * *

The Ingersoll-Rand Co. of New York, has issued a booklet of instructions for installing and operating class "P. E." air compressors. A catalogue covering their line has also been issued recently. These compressors are duplex direct-connected and are electrically driven.

Industrial Notes

George Bradshaw, who since May 1912, has been in charge of the safety department of the New York Central Lines, has resigned to take up the safety work on an independent basis as safety engineer for railways and industrial corporations. Mr. Bradshaw began his railroad career in 1892 with the Chicago & North Western, in the investigation of personal injuries, in which capacity he was employed for seven years, when he entered the service of the New York Central & Hudson River in the same capacity. Three years ago he was assigned to special work in connection with the prevention of injuries, being perhaps the first person ever employed by any railroad of the United States, to devote his entire time and attention to the prevention of accidents. When the safety department was organized on the New York Central Lines, in May 1912, Mr. Bradshaw was put in charge of this department as general safety agent with offices in New York and Chicago.

Mr. Bradshaw, for the last ten years, has given most serious and earnest attention to the causes and prevention of railroad accidents. He has written many articles, pamphlets and books on this subject, the best known being "Prevention of Railroad Accidents," which appeared about a year ago and which at once found remarkable favor among railroad officials of the

George Bradshaw.

United States and Canada, who purchased the work in large quantities for distribution among their employes.

As general safety agent of the New York Central Lines, Mr. Bradshaw inaugurated what is perhaps the most extensive and effective campaign of education among employes ever instituted. This campaign was carried on by means of frequent publications on the subject, the most important of which was "Safety," a 20-page magazine which was distributed to every employe of the New York Central Lines who is able to read English.

Mr. Bradshaw has delivered to officials and employes, a large number of addresses on "Safety." These addresses were illustrated by stereopticon views showing safe and unsafe conditions and practices, and attracted a great deal of attention on the New York Central and other lines. On many occasions the voluntary attendance of employes was from two to four thousand.

During Mr. Bradshaw's administration, as general safety agent for the New York Central Lincs, the following results were secured:

Of eighteen shops, from the smallest to the largest, there was an average reduction in injuries of 42 per cent.

A reduction on the N. Y. C. & H. R. R. R. of 34 per cent in the actual number of fires attributable to locomotives during the year 1912 over 1911, and a decrease of 44 per cent in the amount paid in settlement of fire claims.

A decrease during the last six months of 1912, of 15 per cent in the number of employes killed in all branches of the service and on all lines over the same period of 1911. In fact it was considerably more than 15 per cent owing to the greater number employed in 1912.

As safety engineer, Mr. Bradshaw offers his services to railroad and industrial corporations for the purpose of inspecting roads, shops and plants and advising the necessary action to take in order to prevent injuries. He will also when desired, deliver to officials and employes, lectures on safe methods of operation and work. He is located at Highland, N. Y.

J. W. White, engineering salesman for the Jeffrey Mfg. Co., Columbus, O., located until recently at their Athens, O., offices, has been transferred to Duluth, Minn. Mr. White will look after the sales work of the above company in the eastern part of Minnesota, northern Wisconsin and the upper peninsula of Michigan, with headquarters at 1905 East Superior street, Duluth, Minn.

Roberts & Schaefer Co. have just closed a contract with the Western Maryland for another large Holmen coaling station for installation at William, W. Va.

The Thomas Railway Appliance Co., Guthrie, Okla., has been incorporated by John W. Thomas, of Kansas City, Mo.; J. R. Hamill and Fred W. Green, of Guthrie, Okla. Capital stock is $100,000.

H. F. Ball has been made president of the Economy Devices Corporation, 30 Church street, New York, which has recently been formed. This company has taken over the business of the Radial Buffer Co.

The Federal Signal Co. has bought the property of the American Railway Signal Co., of Cleveland, O., together with all the company's assets and stock on hand. It also will carry out the unfinished contracts for construction.

The Pressed Steel Car Co. has announced the following appointments effective April 1: Charles A. Lindstrom, formerly chief engineer, appointed assistant to president, with headquarters in the Farmers' Bank building, Pittsburgh, Pa.; B. D. Lockwood, formerly assistant chief engineer, appointed chief engineer; J. P. Streib, formerly mechanical engineer, appointed assistant chief engineer, and Felix Koch appointed mechanical engineer.

George M. Basford, assistant to the president of the American Locomotive Co., has resigned to become chief engineer of the railroad department of Joseph T. Ryerson & Son. His office will be at 30 Church street, New York.

Henry Jungerman, formerly in the motive power and inspection department of the Harriman Lines, has been made railway representative of Tate-Jones & Co., Inc., Pittsburgh, Pa.

The Universal Portland Cement Co., a subsidiary of United States Steel Corporation, has started work on the construction of plant No. 7, at Duluth, Minn. This plant will cost about $1,700,000 and will have an output of 1,400,000 bbls. of Universal Portland cement per annum. The plant will be electrically operated throughout, requiring about 5,000 h. p. It is reported that work will be pushed as rapidly as possible, and it is expected that the plant will be in operation in 1914. With its present plants at Chicago and Pittsburgh this will give the company a total output of 45,000 bbls. a day, or 13,500,000 bbls. a year.

The Waugh Draft Gear Co., of Chicago, Ill., has placed the general selling agency for its product in the hands of the Wendell & MacDuffie Co., 165 Broadway, New York, N. Y.

Joseph K. Choate has been elected vice-president of the J. G. White Management Corporation, New York.

The Pedrick Tool & Machine Co., 3640 N. Lawrence street, Philadelphia, Pa., has been formed by A. D. Pedrick and H. A. Pedrick, who have recently resigned from the firm of H. B. Underwood & Co. The new company will make and sell the Pedrick portable tools, including cylinder boring bars, cylinder and dome facers, crank pin turning machines, driving box planer tools, pipe benders, milling machines, radius planing attachments, and valve seat rotary planers.

Samuel T. Fulton, general sales agent of the Railway Steel-Spring Co., has been elected a vice president of the company.

J. H. Craigie, formerly connected with the mechanical department of the Boston & Maine, is now associated with the railroad sales department of Joseph T. Ryerson & Son, of Chicago, Ill. His headquarters are at Boston, Mass.

Rex Gay, formerly with the Ajax Forge Co., Chicago, Ill., has resigned to accept a position with the Verona Tool Works, Pittsburgh, Pa., wih headquarters in the Karpen building, Chicago.

A grading contract has been given to Janse Brothers, it is said, for work on 118 miles of the Bassano-Swift Current line from Bassano, Alta., east, and the work on 90 miles has been sub-let.

The Billings & Eastern Montana is reported to be building a line with its own forces from Billings, Mont., northeast about 15 miles.

The Cincinnati, New Orleans & Texas Pacific will make extensive improvements in the McLean avenue yards at Cincinnati. Eight new tracks will be constructed and the present tracks will be rearranged.

The Hudson River Connecting, a $250,000 concern, was incorporated March 19. The company will build 3 short sections of railway, comprising 25 miles in Albany, Rensselaer and Columbia counties, N. Y., connecting the New York Central & Hudson River, West Shore and Boston & Albany.

The Missouri, Kansas & Texas is reported to be making surveys for an extension of the Wichita Falls & Southern south and west from New Castle, Tex.

The Trona has been incorporated in California with a capital stock of $200,000 to construct a single or double track standard gauge railway from Searles, Kern county, California, in a northwesterly direction into and through San Bernardino to Searles lake on the southern boundary of Inyo county, a total distance of 32 miles.

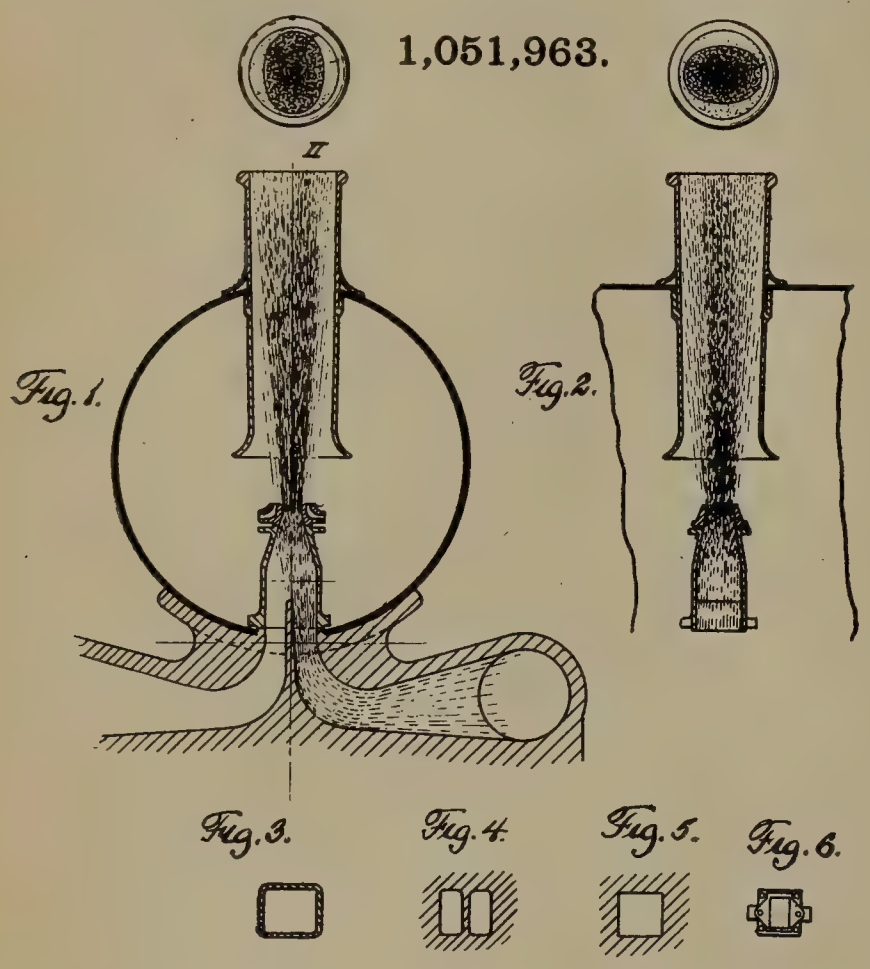
The Williamsport & Martinsburg has been incorporated in West Virginia with a capital of $250,000 to build a road from Williamsport to Martinsburg, W. Va.

Recent Railway Mechanical Patents

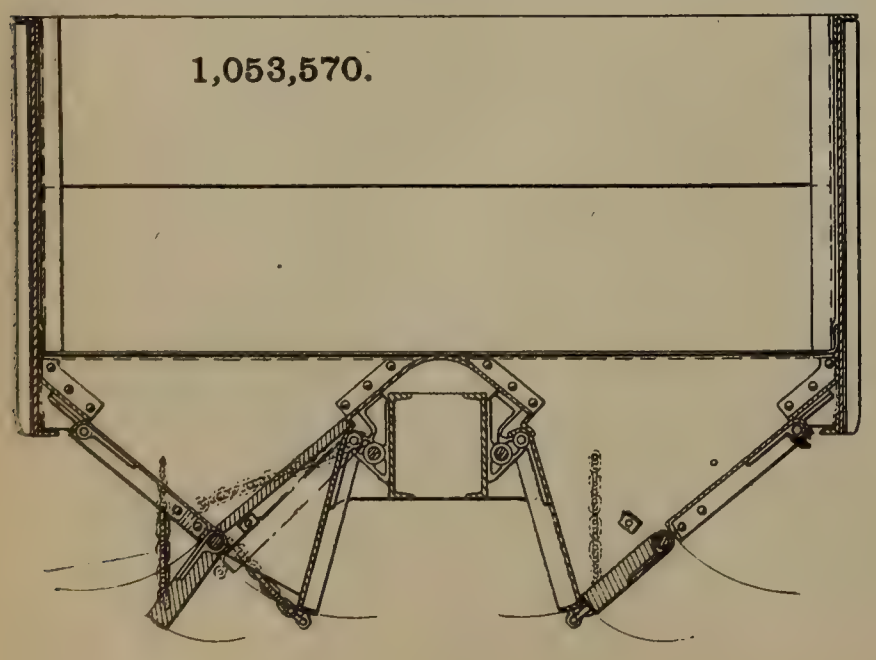
LOCOMOTIVE EXHAUST APPARATUS.

1,051,963—Donald R. MacBain, Cleveland, O.

The primary object of this invention is to provide an improved exhaust nozzle whereby increased draft is obtained and back pressure on the cylinders reduced to a minimum, thus securing greater efficiency in operation. Under the present general arrangement the amount of draft produced by the exhaust depends largely upon the rate at which the steam is delivered from the exhaust tip to the stack, and it has been found that with the use of a round tip there is considerable resistance encountered due to the changing of the exhaust steam from a rectangular to a circular section.



This not only retards the flow of steam from the exhaust nozzle with back pressure in the cylinders as a resultant, but also causes the jet of steam to spread as it leaves the exhaust tip, thus tending to completely fill the stack, thereby proportionately decreasing the amount of gases from the flues which can be entrained in the stack by the draft of the exhaust. One of the chief objects of this invention is to provide a construction wherein the jet of exhaust steam is solidified and the spread thereof reduced, and the above enumerated defects avoided and greater efficiency of draft obtained, and back pressure in the cylinders reduced. This is accomplished by providing an exhaust tip which is of the same relative form of cross section as the exhaust passages as will appear from an inspection of Figs. 1 to 6. As there shown, the exhaust tip is rectangular in cross-section, substantially corresponding to the cross section of the exhaust passages, as shown in Fig. 4. It has been found that with the use of such a construction, the jet of the exhaust steam is maintained in solidified form due to the fact that the jet is not changed in cross section just prior to discharge as in the case with round nozzles, and spreading thereof prevented, the steam being most dense at the central portion of the jet.



INTERCHANGEABLE SIDE OR CENTER DUMP CAR.

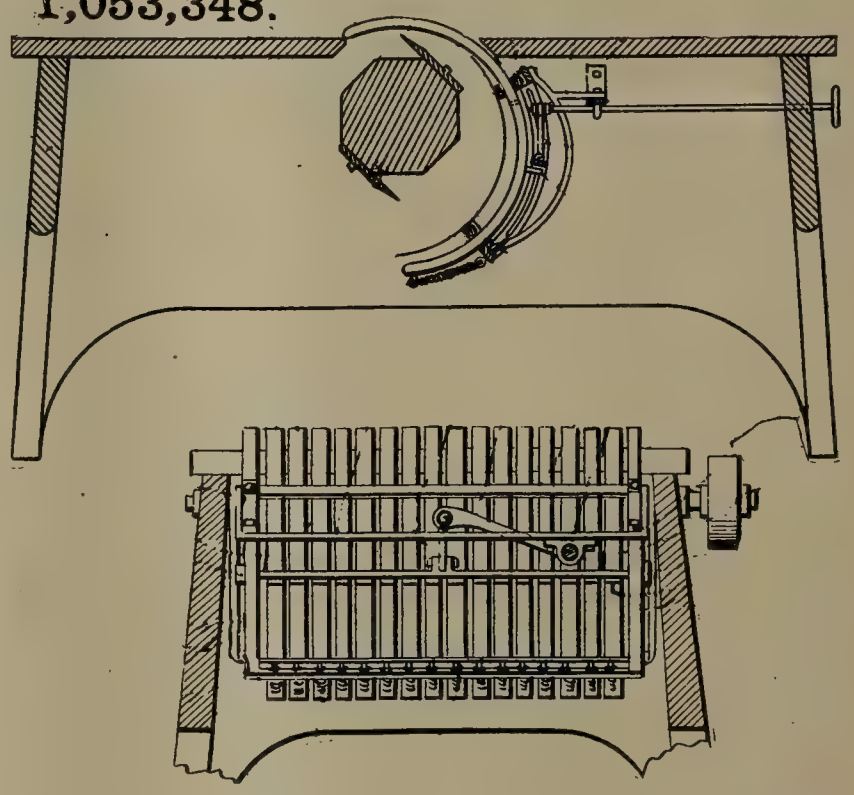
1,053,570—Argyle Campbell, Chicago, Ill., assignor to Enterprise Railway Equipment Company, Chicago, Illinois.

The object of the invention is to provide a dump car which may be used interchangeably for either side or center dumping. Another object of the invention is to provide a construction in which movable diverting boards are used at the bottom of the hoppers for diverting material to either the outside or the inside of the rails, said diverting boards co-operative interchangeably with either the center or side doors of the hoppers. A still further object of the invention is to provide a dump car which uses removable transverse partitions at the ends of the hopper section of the car and to so arrange and design the hoppers that these removable partitions may be stored within the hoppers and the partitions used to help divert the material to the sides of the car. These removable partition boards may still be used in the hoppers in conjunction with the side doors even when the diverting boards are disposed in their inner position. In this case the boards form a cover or closure for the pocket or recess formed by the center doors and diverting boards which would otherwise be filled with a part of the load and which could not be dumped to the side. By forming the hoppers of such length that they are adapted to receive the partition boards, a convenient place for storage of the same is thus obtained and at the same time the partition boards perform an important function in helping to divert the material to the side.

SAFETY DEVICE FOR PLANING-MILLS.

1,053,348—Jose C. Bishop and Benjamin A. Bishop, Birmingham, Alabama.

This safety device consists essentially in a series of depressible guards, which are movable singly or in series, and located with relation to the planing knives in position to guard the operator of the mill from accident. It comprises a series of depressible fingers or guards arranged side by side and extending practically the entire distance between the two sides of the milling machine. These fingers or guards are curved pieces of suitable material, as



metal or wood, and project, when in normal position, through the opening in the table of the milling machine. The guards may be depressed and will move between the upper bar and roller and the lower bar and roller. For returning the guards to normal position, each guard is provided with a spring attached at the lower end of the guard. The entire series of guards may be depressed simultaneously by the hand wheel shown at the right.

STAYBOLT PROTECTOR.

1,046,973—Reginald Christie, London, England.

This patent relates to improved devices for protecting the stay ends and nuts of boilers, and similar projections, from the effects of heat. According to this invention there is disposed around the nut a removable helical, spiral, or other suitably formed coil of metal, or other appropriate material, of convenient section and of any desired number of convolutions, or twists, constituting, as it were, a screw-thread. This coil is held in place on the nut, in any desired manner, and is adapted to engage a cap, or cover, of fire-resisting material, formed, for the purpose in view, with an internal spiral path, corresponding in diameter and pitch with those of the coil, so that when the cap or cover is screwed down over the nut, both the latter and the coil, together with the stay end, or the like, will be protected from the injurious effects of heat.

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AUTOMATIC STOPS.

Considerable interest has been created by the efforts of the New York, New Haven & Hartford to secure, by test, a practical and efficient automatic train stop. It is understood that as soon as the installations can be made two devices will be given thorough trial. One of the devices is almost entirely electrical in its operation, while the other is mechanical.

Until the tests are concluded it is distinctly unsafe to predict the success or failure of either of the devices. As a matter of fact, however, the winning installation in these tests will not necessarily prove the marked success of a certain type, but it will give considerable impetus toward the ultimate perfection of one of the types mentioned. The type of stop which places no electrical equipment on the steam locomotive is looked upon with favor by many railroad officers of the engineering and signal departments and by practically all officers of the mechanical department for obvious reasons. Whenever it can be avoided, the use of electrical devices on steam locomotives is to be deprecated. In the case of the stop mechanism, electrical equipment on the locomotives will involve the signal department in locomotive repairs in both roundhouse and shop. If this situation proves unavoidable, the work can, of course, be co-operatively performed without serious difficulty. On the other hand, if the stop adopted is the one which is operated mechanically as far as the locomotive is concerned, the matter is simplified at the start.

On electrified lines the devices are perhaps more nearly on a par at the start, as electrical automatic stop equipment on electric locomotives is less objectionable. The mechanical stop is, however, equally adaptable to this class of power and the same advantages hold to a slightly lesser extent.

A feature in the operation of stops, concerning which there is considerable difference of opinion, is the advisability of allowing for the immediate restarting of the train at the option of the engine crew after a stop has been made. It is probable that a compromise adaptation will be made. It is, however, necessary for the success of a type that it be capable of allowing immediate restarting or of enforced delay of a certain predecided interval before it will be possible for the engine crew to proceed with the train.

GOVERNMENT BOILER INSPECTION.

The law requiring the proper inspection and repair of locomotive boilers has now been in operation nearly two years and while mechanical officials are of course familiar with its provisions, there have remained a number of points in the law, the interpretation of which was uncertain or varied. At the time of its enactment many thought that the plan of keeping track of the sixty thousand locomotives in the United States with a force of some fifty boiler inspectors seemed very impracticable and that such a law could not result in much betterment. Still it has resulted in good, undoubtedly; the number of accidents have decreased and the amount of information relative to conditions causing such accidents has increased. Right here we feel called upon to remark that the "Safety First" movement has probably contributed its share of good work in this branch of railway work.

The government inspectors themselves have probably not had an easy time of it during the past year or two. The territory to be covered was large, the law was in need of interpretation and

their duties perhaps were not always pleasant. Railway officials have always tried to comply with the law, but it has been impossible for them to be in every boiler shop and repair shop, and it was sometimes difficult to instill into the men an exact compliance with the law.

We believe, however, that the boiler inspectors and the railway officials are now coming to a better understanding and are working together for the good of all concerned. As chief inspector, John F. Ensign said in a recent address: "It's just a big business proposition; something for all of us to do, and if through our combined efforts we keep some fellow citizen from personal injury or death, we have done something worth while. If we can collectively be the means of saving some fellow citizen's life or limb, I feel that we will have accomplished much."

During the past few months Mr. Ensign and his assistants have delivered a number of addresses before various railway clubs on the work of the government inspectors. A couple of months ago Mr. Ensign delivered an address before the St. Louis Railway Club, and at the April meeting of the Western Railway Club his assistant, Mr. McNanamy, gave a similar address. These men gave the impression of being broad men who were working on a big problem and were trying to solve it to the best of their abilities. It is to be hoped that Mr. Ensign and his assistants may be heard before every railway club in the country. It brings the inspectors and railway officials into closer harmony; it enables them to get together and clear up obscure points. At the conclusion of Mr. McNanamy's paper, one member said that he hoped that Mr. McNanamy would appear before the club again in the near future, so profitable had the meeting been to him. At these meetings the discussions and the questions put to the inspector, together with his answers have in themselves proved of great value, aside from the tendency toward greater harmony.

The limited number of government inspectors could never be expected to do the actual work of inspection. Their work is to see that the inspection is done by the railways; their duty is to see that the object of the law—the promotion of safety—is attained. The strength of their work lies in the development of the facts as to the cause and effect of every boiler disaster on every railway, and they can use this information for the betterment of American railway service. The government inspectors are a clearing house of locomotive boiler accidents. Every member of this clearing house will, under the broad minded policy of Mr. Ensign and his assistants, reap the benefit.

MAY CONVENTIONS.

The month of May has arrived bringing with it the reminder that the summer convention season has rolled around again. It is a good season, full of profit and pleasure to everyone who is interested in one or more of the dozen railway associations in the mechanical field. There is strength; there is a shoulder to shoulder feel in getting together with a bunch of men from all over the country who are doing the same things you are; who are having the same troubles you are. The railway man who is not affiliated with some railway organization is losing a great deal; not alone in the value of the papers and discussions but in fellowship as well.

During this month there are four mechanical conventions and elsewhere in this issue we present short articles by the secretaries of these various organizations, defining the history and growth of the associations. The fact that these organizations are active and useful today is due in each instance to some one man or group of men who forsaw the place such an organization could fill; who gave of their time and money for the good of all in their profession. It is a great deal easier to keep a train rolling than it is to start it; it is much easier for the present members to do their share in committee and other work than it was for the original members to start the ball rolling.

So we hope that the May conventions will be well attended and enthusiastically supported. Their work is varied and important. The Air Brake Association at St. Louis returns to the scene of its birth, for here the meeting was held which germinated the idea of banding together those interested in the device which has had so much to do with the development of American railways. The next May convention of interest to mechanical men is that of the Railway Storekeepers Association. This association has done great good in bringing together and making a power of a branch of railway service which formerly was given but little attention and which had a comparatively small amount of prestige. Thanks to this association, this department has been put on a proper basis and deservedly, for the store is a vital part of a railway system.

Following the Storekeepers comes a young association, but one which has made rapid strides—the International Railway Fuel Association. Certainly the subject of fuel is an important one, not only to the mechanical, but to all departments of a railway organization. As Mr. Hall, the secretary, says: "The handling and use of fuel on railroads is so general in its relation to various departments that the membership has not been confined to any one department but has been extended from presidents to traveling engineers."

During the latter part of May the Master Boiler Makers hold their convention at Chicago, and the work of this well established organization is so well known as to necessitate little comment. Boiler construction and inspection has been brought into the limelight of late and this is an especial chance for the boiler makers to shine.

These associations are doing their part in promoting railway progress. They are specialists; each endeavoring to perfect the work to which it is dedicated. Each association will give to you what you put into it.

YARD BRAKE TESTING APPARATUS.

For the purpose of testing and adjusting air brake equipment in the yards a large amount of compressed air is used in charging. When the yards are not fitted with high pressure lines conveying the air from central power stations where efficient compressors are used, it is frequently the case that small locomotive air pumps are installed in numbers to supply the demand. That this is a most uneconomical arrangement is undisputed, but it is doubtful if the waste of the practice is fully realized.

Where the testing and adjusting is done after a locomotive has been attached to the cars, there is also considerable waste, but not as much as in the former instance, because the air pumps on the locomotives are usually kept in better operating condition than are those scattered about the yards. Brake apparatus tested after the locomotive has been attached to the made-up train is not, however, apt to be as thorough as is the case where less hasty measures can be taken.

The best practice is that which affords modern air compressor service to all parts of the yards. Electrically driven units can be located in almost any large yard without power transmission difficulty, and the economy of such arrangement becomes immediately noticeable in the fuel costs and in better air brake service.

CLASP BRAKES.

In a paper read by C. U. Joy before the New England Railroad Club, mention was made of the necessity for the use of the clasp type in foundation brake rigging. This necessity is acknowledged by most well informed mechanical men and is due to the fact that increased brake pressures, which would be otherwise quite possible on heavy equipment, cannot be used without danger of displacing the journals in their boxes. Moreover the heat generated by the pressure is such as to melt the metal of the shoes and to wear them away so rapidly as to make a maintenance of accurate adjustment impossible.

F. M. Nellis, of the Westinghouse Air Brake Co., expressed the opinion that the clasp type of brake will of necessity be used on all heavy equipment in the near future. Tests now being carried on by both the Pennsylvania and the New York Central will probably result in the perfection of a design for clasp brake rigging which will obviate the disadvantages of the type used in the past.

TRAVELING ENGINEERS' CONVENTION.

At a meeting of the executive committee held May 1, it was decided to hold the next annual convention of the Traveling Engineers' Association at the Hotel Sherman, Chicago, on August 12, 13, 14 and 15, 1913. This will mark the third consecutive year that this association has met at Chicago, during which time it has grown remarkably in numbers and importance. A list of the subjects to be taken up at this, the twenty-first annual convention, was published on page 101 of the March issue of the *Railway Master Mechanic*. Those who attended the conventions of 1911 and 1912 look forward to the 1913 convention and it is probable that it will be a record-breaker.

AN ELECTRIC SIGN for the Chicago & North Western has been erected in Chicago near the river front and facing the Rush street bridge. It shows a Pacific type locomotive approaching an automatic semaphore, which is in a clear position. Every few seconds the signal drops to a stop position and the drivers cease revolving. Above is the trade mark of the Northwestern Line and underneath are a few lines of advertising. The sign is fifty feet square, contains 3,860 lamp sockets and weighs 37,500 pounds.

THE EXHIBITS on Young's Million Dollar Pier at the Mechanical Convention at Atlantic City in June will be open for visitors on the evening of Monday, June 16. A move in this direction has been advocated for some time and this marks a step towards that end.

THE RAILWAY BUSINESS ASSOCIATION has moved its offices from 2 Rector street to room 739, 30 Church street, New York.

LOCOMOTIVE PRACTICE AND RESEARCH.

The charge is sometimes leveled at locomotive engineers that, compared with others connected with the development of steam practice, they show but little progress. It is, of course, a fact that the bulk of the locomotives at present running are simple non-condensing engines with tubular boilers of a type developed long ago. On the other hand, starting rather later, the marine plant has been brought to a high pitch of perfection by the use of hot feed, superheating, and compounding, to say nothing of the more recent developments of turbines and mechanical gearing. The marine engineer has, in fact, tried most of the possible schemes of making the most out of heat available, whereas locomotive men are apt to insist that for their work there is nothing like the ordinary engine. The reasons for this are not obvious to the outsider, but are nevertheless cogent. The actual working time of a locomotive, on which any improvement can alone justify itself, does not occupy the whole working life of an engine. The result is that when lighting up coal, consumption during standing time, light mileage, and other factors are included, as these are similar to all engines in one class of traffic, small economies, which would be appreciable on a long spell of regular running, are reduced in proportion. As the financial aspect has to take into account the whole time of the locomotive, and not only that spent in service, it is still more acute. Savings may not be completely swamped, perhaps, but, being on only a portion of the whole, they do not show up so well as is expected from claims made on test results. It would not be reasonable, therefore, to accept as absolutely reliable, as was done by a speaker in a recent discussion at the Institution of Mechanical Engineers, a high figure for economy shown by the records of the coal-stage, when more careful tests showed a lower figure. In service some discount would be expected off the test figures even if they were for regular working conditions; and if, as they did in the case referred to, they related to fuel consumption for running time only, the figures could scarcely be expected to be fully maintained, and certainly not exceeded, by over-all results.

The same reason probably accounts for the fact that the exhaust steam injector sometimes fails to show more than a small saving over a long period. The saving which accrues by its use is overshadowed. In this, as in other instances, there is also the additional chance that the appliance may not be kept in use to the utmost extent possible, there being always a stand-by injector available if the men insist on using it. Clearly, therefore, it is desirable not to stop at any one system capable of producing small economies on test, but to work towards making the whole plant efficient, so that for the work done as little coal as possible need be burnt, and as little as possible of the heat available rejected. The larger the showing for any system, the more valuable will be its ultimate effect on the coal bill, since the incidental coal consumption remains constant. There is thus no reason why locomotive engineers should rest content, as so many seem inclined to do, at any system giving, say, 20 per cent economy. We heard recently of an American superintendent of motive power, who, though he had used feed water heating quite satisfactorily for a number of years, was now turning his attention to superheating, as he thought there was more to be got out of that. Taken separately, that may or may not be so—it probably is if superheating be carried far enough; but the two systems are not antagonistic. They can be combined without interference. Engineers in other practice would be very reluctant to agree that they might be used as alternatives, and not in combination.

It is interesting to notice from the recent discussion at the institution that while feed-heating by direct condensing has shown a considerable saving on the London, Brighton and South-Coast Railway, the exhaust-steam injector, which, after all, is a condenser, showed very small savings on the Lancashire and Yorkshire and on the Great Northern Railways. The dif-

ference in the feed temperatures attained hardly seems to account for the large difference in the economies reported. The condensing system of feed-heating may carry the temperature to 210 degrees Fahr. Higher temperatures may be obtained, however, with proved advantage, for some conditions at least. It is clearly worth while to work in the direction of the highest feed temperature, no less than it is advantageous to adopt the best arrangement of superheating.

As regards the various aspects from which the superheating questions must be viewed, the discussion last week at the institution was disappointing. The story so assiduously propagated, from German sources, that there is no gain for the first 100 degrees Fahr. of superheat was again brought forward, although Mr. Churchward had stated that he was getting satisfactory results with an apparatus giving little more than that amount. It has always been difficult to understand why there should be, so to speak, a critical point at the 100 degrees. Especially is this so in the face of authenticated figures on record showing very appreciable economies for the moderate degree systems. Two speakers, we think, on this matter of superheating, offered rather loose criticism of the paper. They argued that efficiency of generation was of no moment compared with the net result of efficiency of generation and consumption. Nowhere in their paper did the authors suggest otherwise, but they were none the less perfectly justified in pointing out that if two systems giving approximately the same degree of superheat were compared, that having the benefit of higher efficiency of generation would have the advantage. In view of the facts adduced with regard to cheapness of conversion, such a comparison was quite proper, and was more complete than that made by speakers in the debate.

There is no doubt, of course, that efficiency of generation is a matter of importance. The ideal would be to combine a high efficiency in this direction with high efficiency in the engine. At present the high-degree superheater system proves satisfactory because the gain in the engine more than counterbalances the loss in the generator; but if the future develop a high-degree superheater more efficient than the present smoke-tube system, it will secure a distinct advantage. The substitute would naturally also have to commend itself from the practical point of view. This again is a point on which there is a great tendency to confuse issues. All smoke-box heaters, for instance, are not alike, and they cannot all be sweepingly condemned as objectionable in type. They differ so materially in design and application that some are undoubtedly less open to criticism than others.

The practical point of view must ever be borne in mind, of course, as must also the financial. It would appear, however, that recent developments as regards locomotive engineering have suffered rather from an excess of "business talk," and from a lack of careful engineering investigation. If a system backed by sound principles does not justify itself, it ought to be possible to bring the cause for the failure home more commonly than is usually done. There is also much conflicting evidence which it is extremely difficult to reconcile. The suggestion, therefore, made by Mr. Churchward, that engines might be built to joint design and worked over several associated lines in turn, is extremely interesting. Were such a scheme feasible, it might afford some explanation for many conundrums now insoluble; but we must admit that we do not think the scheme to be very practicable. The second suggestion made, that the Institution of Mechanical Engineers might perhaps find it possible to embark upon research work of the kind conducted at Purdue and Altoona, in the United States, seems to afford an easier way of settling some of the points in dispute. The Great Western Railway possesses at Swindon an excellent locomotive testing plant, and if the company could be prevailed upon to give facilities to a research committee appointed by the Institution for testing locomotives on it, valuable decisions might be arrived at from its use. There would, we fancy, be little difficulty in finding a suitable man to put in charge of the work. An investigator such as, perhaps, Professor Dalby would do excellently, and much of the work might be carried on as a vacation course for one of the engineering colleges, by which plan plenty of voluntary assistance would be assured. The bulk of the expense could come out of a common fund subscribed to by various railway companies, and such companies would probably welcome the chance of having their locomotives tested. There are points of engineering moment on which such tests give a much clearer indication than do the ordinary road tests, in which results are fogged by a multitude of variants.

It is surprising that with all our endeavors to make headway in engineering science, with schools and colleges up and down the land, only recently has railway engineering been taken at all seriously. In America, it must be admitted, they are paying this large branch of the profession more of the attention which is its due. In addition to the Pennsylvania testing plant, on which so many tests have been carried out, there are, besides less known plants, two important installations for locomotive testing at Purdue University, Indiana, and at the University of Illinois, Urbana. At the former plant, inaugurated by, and for long in charge of, Dr. W. F. M. Goss, there is in use a locomotive, of comparatively small size, which has been altered from time to time, so that the research might cover various modern developments. At the new installation at Urbana, Dr. Goss has a plant which is capable of being adapted to almost any large locomotive up to and including those of the eight-coupled type. No special engine is provided for this plant, and it will be made available for railway companies generally. It is anticipated that the railroad companies will freely avail themselves of the facilities for having engines tested on it; and with Dr. Goss as Dean of the College of Engineering, and Professor E. Schmidt as Professor of Railway Engineering, we may expect that valuable results will accrue, and that they will be as freely published as the results of other investigations have been in the past at Purdue and at the University of Illinois. It would be a great thing if by some means similar investigations on representative British locomotives could be carried on here, and we hope the suggestion made last Thursday evening at the Institution of Mechanical Engineers will bear fruit. At present little is accurately known of British locomotive performance and very little of a truly comparative nature. Tests on a suitable plant might lead to much enlightenment, and, if undertaken on a well-organized scale, might be arranged to show the effect of variations between types, and also between engines of the same class embodying different developments.—*Engineering*, of London.

THE MISSOURI PACIFIC-IRON MOUNTAIN has just about completed the laying of the heavy 90-pound steel rail authorized under last year's program of track improvement on the system. A vast quantity of it has been put on the main through line to Colorado and the west, including one solid stretch of sixty miles between Sedalia and Pleasant Hill. The rail also went on the main line of the Kansas Division between Leeds, Mo., and Stillwell, Kansas. There was another stretch laid on the Omaha division between Kansas City and Leavenworth. On the main line to the south considerably over 100 miles have been relaid between Kimmswick and Poplar Bluff on the Missouri division, and nearly as much on the Arkansas division between Little Rock and Texarkana.

THE FIRST LOCOMOTIVE to be tested at the new locomotive laboratory of the University of Illinois arrived at the university on April 11. It is an Illinois Central consolidation freight engine having a total weight with tender of 182 tons, 100 tons of which are supported on the drivers. It is now being tested out. The laboratory was formally opened on May 9 and addresses were made by a number of prominent railway men, including W. L. Park, F. H. Clark, D. F. Crawford, C. B. Young, Robert Quayle, T. H. Goodnow, B. A. Worthington and H. G. Hetzler.

Mikados for the Lake Shore

In the selection of power for freight service the effect of the various types and sizes on the operating costs should go a long way towards determining the most economical engine to choose. Many railways are making remarkable reductions in operating costs by acquiring locomotives powerful enough greatly to increase train loads. Increased train loads at high rates of speed demand large sustained tractive efforts. As this requires great quantities of steam, proportionately larger heating surface must be provided. Since the general construction of the Mikado type locomotive permits of very ample steaming capacity and thus of high sustained tractive efforts, it is fast supplanting the Consolidation type as the standard freight engine.

The freight traffic of the Lake Shore & Michigan Southern has formerly been handled by Consolidation type locomotives. The steaming capacity of the Consolidation type locomotive is necessarily limited, since the entire boiler and firebox must be carried over the drivers. These boiler limitations are now becoming serious and the Lake Shore officials, after careful consideration, placed an order with the American Locomotive Company for the twenty Mikado type locomotives herewith illustrated.

These locomotives have been placed in service on the Toledo, Eastern and Franklin divisions. Three runs were made between Coalburg and Carson, a distance of 47 miles, as follows:

	No. of Cars	Train Load	Average Speed, Excluding Delays
1st run	100	6,495	14 ½ miles per hr.
2nd run	102	6,680	14 ½ miles per hr.
3rd run	100	5,859	14 ¾ miles per hr.
Average	100	6,345	14.58 miles per hr.

A superheater Consolidation, class G-46, can handle an average train load of 4,250 tons. This shows an increase of 49.3 per cent in train loads in favor of the Mikado.

These runs were made on the Franklin division, in order to determine just what the maximum tonnage was that the engines could handle, and do not represent the average tonnage hauls of these engines.

The following loading orders have been put into effect over the different divisions:

	Mikados Superheat Engine	G-16 (2-8-0 Type) Superheat Engine	G-5 (2-8-0 Type) Superheat Engine
Eastern Division Out of Collinwood—			
Train Load, tons	4,300	3,200	2,900
Mikado vs. G-16	134%	100%	...
Mikado vs. G-5	148%	...	100%
Out of Seneca—			
Train Load, tons	3,500	2,600	2,300
Mikado vs. G-16	134%	100%	...
Mikado vs. G-5	152%	...	100%
Franklin Division Out of Youngstown—			
Train Load, tons	4,300	3,400	3,100
Mikado vs. G-16	127%	100%	...
Mikado vs. G-5	139%	...	100%
Toledo Division—			
Train Load, tons	3,500	3,000	2,600
Mikado vs. G-16	116%	100%	...
Mikado vs. G-5	135%	...	100%

As these Mikado engines have only been in service a short time, the officials have not been able to make any comparison as to water consumption. A record of the coal consumed has been taken for several different classes of engines on the Eastern and Michigan divisions. These records are shown in the following table, and each represents the average of three round trips.

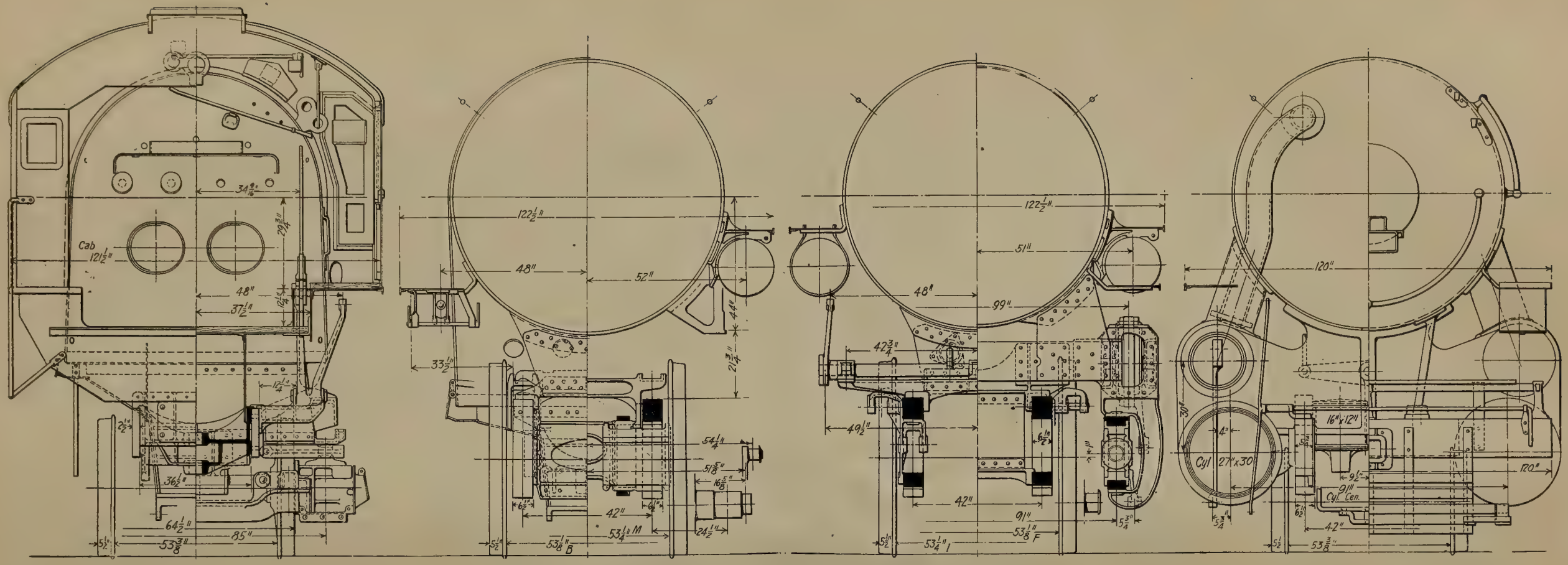
Type	Steam	Total Weight	No. of Cars	Train Tonnage	Tons of Coal per Trip	Miles per Ton of Coal	Ton Mi. per Ton of Coal
2-6-2	Saturated	245,000	42	1,312	10.6	12.28	16,100
2-8-0	Saturated	168,000	43	1,499	16.5	7.87	11,800
2-8-0	Saturated	180,000	41	1,585	13.1	9.93	15,700
2-8-0	Saturated	240,000	65	1,961	15.4	8.44	16,500
2-8-0	Superheated	241,000	60	2,335	15.9	8.17	19.100
2-8-2	Superheated	322,000	70	3,203	12.85	10.1	32,400

Although the Mikado figures have probably been favorably affected by the cars in the train being loaded more heavily, they show the reductions which will be obtained in operating costs.

The design in general follows the standards of the builder. Their success will once more prove that it is possible to secure enormous power without the use of a single doubtful or untried feature of design or construction.

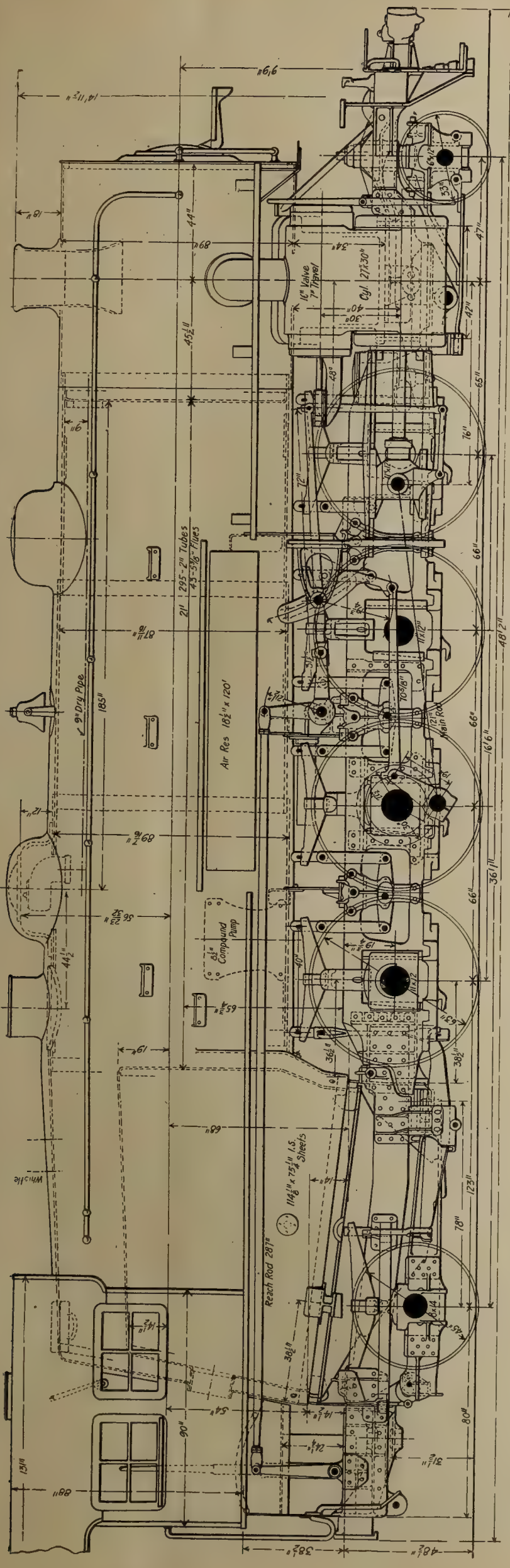
The boiler was given special attention, and the builder's latest knowledge of boiler proportions was applied. It is 86 inches in diameter outside at the first course and 89⅜ inches in diameter outside at the largest course. The barrel is fitted with 295 tubes, 2 inches in diameter and 21 feet long. A 43 unit, Schmidt type, top header superheated was also applied. The firebox is 114⅛ inches long by 75¼ inches wide, and combines a firebrick arch and the railroad company's standard arrangement of combustion tubes. The good steaming qualities of this boiler equipped with superheater, firebrick arch and combustion tubes, should be materially increased by the pneumatic firedoor applied, the latter holding the influx of cold air to the firebox down to the minimum. Five of these engines also included the O'Connor firedoor flange. An inspection manhole, independent of the steam dome, was provided for the purpose of making the periodical interior boiler inspections without the necessity of taking down the throttle valve and stand pipe.

Type	282	280	280	280
Class	H-7	G-16	G-5	G-46
Weight on driving wheels, pounds	245,000	214,400	208,000	212,000
Weight on leading truck, pounds	27,500	26,100	26,000	31,000
Weight on trailing truck, pounds	49,500	.....	.....	.....
Weight, total of engine, pounds	322,000	240,500	234,000	243,000
Weight of tender, pounds	155,800	153,200	153,200	152,000
Wheel base, driving, feet and inches	16-6	17-6	17-6	17-3
Wheel base, total of engine, feet and inches	36-1	26-5	26-5	26-5
Wheel base, total of engine and tender, feet and inches	68-10½	60-11½	60-9½	58-2¾
Cylinders, diameter and stroke, inches	27x30	25x32	23x32	23x30
Valves, type	Piston	Piston	Piston	Piston
Valve gear	Walschaert	Walschaert	Walschaert	Walschaert
Wheels, diameter of driving, inches	63	63	63	57
Wheels, diameter of truck, inches	33	33	33	33
Wheels, diameter of trailing, inches	45	.....	.....	.....
Wheels, diameter of tender, inches	36	33	33	33
Journals, driving main, inches	11½x22	10½x14	10½x12	10½x12
Journals, driving others, inches	11 x12	9½x12 & 14	9½x12	9½x12
Journals, truck, inches	6 x12	6 x12	6 x12	6 x12
Journals, trailing, inches	8 x14	.....	.....	.....
Journals, tender, inches	5½x10	5½x10	5½x10	5½x10
Boiler, type	Straight top	Straight top	Straight top	Con. Conn.
Boiler pressure, pounds	190	180	200	200
Boiler, outside diameter, front end	86	81⅝	81⅝	80
Boiler, outside diameter, back end	89⅜	83¼	83¼	87½
Firebox, length, inches	114⅛	108⅛	108⅛	108⅛
Firebox, width, inches	75¼	75¼	75¼	73¼
Tubes, number and diameter, inches	295-2	262-2	268-2	294-2
Flues, number and diameter, inches	43-5⅜	34-5⅜	34-5⅜	36-5⅜
Tubes, length, feet and inches	21-0	15-½	15-½	15-6
Heating surface, tubes, square feet	4,494	2,767	2,814	3,066
Heating surface, firebox, square feet	218	212	212	202
Heating surface, arch, tubes, square feet	28	27	27	27
Heating surface, total, square feet	4,740	3,006	3,053	3,295
Superheating surface, square feet	1,084	555	555	605
Grate area, square feet	59.6	56.5	56.5	55.8
Water, capacity of tender, gallons	7,500	7,500	7,500	7,500
Coal, capacity of tender, tons	12	12	12	16
Length over all, engine and tender, feet and inches	78-5	69-10¼	71-5¾	68-9¾
Extreme width, feet and inches	10-2½	10-2½	10-3½	10-3
Extreme height, feet and inches	14-11½	14-8 3 16	14-10¼	15-2½
Tractive power, maximum, pounds	56,100	48,600	45,700	47,300



Sections of Mikado for the Lake Shore & Michigan Southern.

Mikado for the Lake Shore & Michigan Southern.



Elevation of Mikado Locomotive, Lake Shore & Michigan Southern.

Other interesting details are the latest arrangement of outside steam pipes, self centering valve stem guide, the improved outside bearing radial trailing truck and the long main driving boxes.

Additional strength without increased weight was secured by the liberal use throughout the design of vanadium steel for many of the principal parts. Some of the parts constructed of this alloy steel are—main frames, driving axles, driving springs, tender truck springs, main and side rods, main rod straps, and piston rods. Vanadium cast iron was also used in the cylinders. In addition vanadium steel has been used on 10 of the engines for the wearing parts of the valve motion. The particular parts are as follows: Eccentric crank bushings, eccentric crank pins, links, link blocks, link trunnion bushings, link arm bushings, combination lever bushings, crosshead arm bushings, combination link pins, combination lever pins, radius bar pins, valve rod crosshead bushings and link block pins.

Through the use of vanadium steel, the front, rear and intermediate axles have been reduced to 9¾ inches diameter between the journals which are 11x12 inches. This is ¾-inch less in the case of the front and intermediate axles and 1 inch less in the case of the rear axle than common practice would require for carbon steel axles with journals of the above sizes in locomotives of this type. This means a considerable reduction in weight, which is important.

The tender is fitted with railway company's standard 7500 gallon, 12 ton capacity, waterbottom tank, the Commonwealth cast steel frame, the Commonwealth cast steel trucks and railway company's standard waterscoop arrangement. The comparison on page 177 of the new Mikados and the Consolidations replaced, is interesting.

WESTERN RAILWAY CLUB'S ANNUAL MEETING.

The annual meeting of the Western Railway Club will be held at the Auditorium banquet hall May 27th, at which the regular election of officers for the ensuing year will be held. This will be followed by the customary entertainment, which promises to be more unique and striking than any preceding it. The fact that the arrangements for this entertainment are being looked after by W. B. Hall, Chairman of the Entertainment Committee, is sufficient assurance of its success. Those taking part in the entertainment are:

J. L. Ponic, J. L. Ponic Railway Supplies.
Frank Ryan, Pittsburgh Spring & Steel Co.
Albert Young, International Harvester Co.
J. Roy Andrews, H. W. Johns-Manville Co.
G. L. Voss, Illinois Trust & Savings Bank.
Geo. Hull Porter, Western Electric Co.
Jos. H. Kuhns, Republic Rubber Co.
Frank A. Buckley, F. A. Buckley Co.
Fred S. Hickey, Dearborn Chemical Co.
W. E. Kelley, Patton Paint Co.
W. B. Hall, Union Railway Equipment Co.
J. B. Forsythe, Forsythe-Harding Paper Co.
J. Will Johnson, Pyle-National Electric Headlight Co.,
Geo. Royal, Nathan Mfg. Co.
C. B. Royal, Standard Oil Co.
Geo. H. Bryant, Thos. Prosser & Son.
Jno. Ball, C. & N.-W. Ry.
Jos. W. Taylor, Sec., Western Railway Club.
W. A. Bendfell, Western Electric Co.

The friends of members are cordially invited to attend this meeting and the entertainment committee promise several unique thrillers that have never been attempted before.

"It ain't no use to grumble and complain;
It's jest as cheap and easy to rejoice.
When God sorts out the weather and sends rain,
W'y, rain's my choice."—*James Whitcomb Riley.*

SMOKE ABATEMENT AT CHICAGO.

As is well known, the subject of smoke abatement in Chicago has been given a great deal of attention during the past few years, due to the agitation on the subject of the electrification of steam railways, and the roads entering the city have tried out various devices with a view of reducing the amount of smoke to a minimum.

Some months ago Mr. Monnett, smoke inspector for the city of Chicago, called the attention of the General Managers' Association to the fact that, whereas certain appliances for preventing smoke from stationary boilers had become generally recognized, there was wide difference of opinion among the railways as to the most efficient locomotive smoke preventing device—each road maintaining that the devices used by it were best.

The General Managers' Association accordingly appointed a special committee consisting of representatives of the mechanical departments of the Pennsylvania, Chicago & North Western, Chicago, Burlington & Quincy, Chicago, Milwaukee & St. Paul and the Chicago & Western Indiana railways, which committee was asked to make comparative and efficiency tests of the several smoke preventing devices. This committee was proffered the use of the very complete locomotive testing plant of the Pennsylvania, at Altoona, Pa., with its corps of engineers, and this made it possible to run any class of locomotive desired, at any required speed and pulling any desired load, using various grades of coal, but particularly that from Illinois, which coal was shipped to Altoona for these tests. Elaborate details were worked out so that among others, the following facts could be determined:

Steaming qualities of various grades of coal.
Amount of cinders thrown from stack.
Hauling capacity of the locomotive.
Amount of steam made per pound of coal.
Exact amount of steam required for various types of blowers.
Efficiency with and without brick arches.
Efficiency of air and steam jets above the fire.
Analysis made of the coal, sparks, ashes and gases.
Relative amount of smoke in each case.

The extensive data covering these tests has been worked up and will be presented at the June convention of the American Railway Master Mechanics' Association. In brief, it was found that either the double or multiple tip blower nozzles should be used; that the grate should have not less than thirty per cent air opening; that sufficient air tubes should be provided about the fire, so that a total of two thousand cubic feet of air per minute could be supplied by means of steam jets, the nozzles of which shall be located eight and one-half inches from inside ends of tubes; that the brick arch prevents smoke to a greater degree while the locomotive is running than when standing, and that such arch gives best results when fitted tight up against the flue sheet; and lastly, that there is advanage in a large quick-opening blower valve.

The roads entering Chicago are rapidly equipping their locomotives in conformance with the recommendations found in this test report. The Chicago & North Western, for instance, already has about 80 engines equipped with the devices. On April 15 the North Western invited a number of officials and others interested to take a trip behind one of its engines so equipped, with a view of demonstrating the practical results obtainable. The following were present: O. Monnett, smoke inspector, city of Chicago; T. H. Curtis, mechanical engineer, Chicago Association of Commerce Smoke Abatement Commission; H. Pattison, electrical engineer, and B. Hoffman, chemist, of the smoke abatement commission; M. E. Harris, deputy smoke inspector, city of Chicago; M. K. Barnum, G. S. M. P., Illinois Central; Robert Quayle, S. M. P. & M., Chicago & North Western; W. O. Moody, mechanical engineer, Illinois Central; H. T. Bentley, A. S. M. P., Chicago & North Western; W. M. Baxter, mechanical inspector, Illinois Central; J. H. Lewis, chief smoke inspector, Chicago, Burlington & Quincy; E. W. Pratt, A. S. M. P., Chicago & North Western; O. W. Middleton, editor, *Railway Master Mechanic;* E. F. Jones, M. M., Chicago & North Western; G. B. Schrand, superintendent freight terminals, Chicago & North Western; R. E. Thayer, associate editor, *Railway Age Gazette;* W. H. Bentley, representing the Baldwin Locomotive Works; C. W. Corning, smoke inspector, Chicago & North Western; J. M. Lammedee, assistant editor, *Railway & Engineering Review;* James O'Brien, Kingston, Ont. and W. R. Smith, master mechanic, Chicago & North Western.

The engine used was North Western switch engine 2015, class M-1 equipped with superheater and built by the Baldwin Locomotive Works, in February, 1913. It is equipped with side steam jets with capacity of 2000 cubic ft. of air per minute, Loedige quick opening blower valve, brick arch, air opening in fire-box door, double blower jet in front end, grates with 35% air opening and in fact all the arrangements and devices recommended as a result of tests made at Altoona, Pa., for the reduction of smoke. The side steam jets were located at a distance of 8½ inches from the inside lining of the firebox, as this distance was found to give the best results in the tests before mentioned.

The day was bright and clear, and the stack could be plainly observed from the observation car at the rear. A run was made out to Proviso with a load of between 800 and 900 tons of coal and the return run was made with a load of 1150 tons of washed gravel. The trip proved very satisfactory, no black smoke being emitted at any time during the run and the exhaust being scarcely visible most of the time.

At Proviso the party reviewed the modern new terminal of the North Western at this point and also witnessed a very interesting test of the smoke preventing devices. While the engine was standing here, the blowers were shut off and the engine was allowed to emit a dense black smoke. The blowers were then turned on and the heavy black smoke was changed to an almost invisible haze in a period of five seconds. This experiment was repeated a number of times, the results always being the same.

In addition to this work along the line of smoke prevention made under the direction of the General Managers' Association, they have appointed a standing committee consisting of M. K. Barnum, (chairman) Illinois Central; H. T. Bentley, Chicago & North Western and E. F. Jones of the Belt Railway, all of whom have offices in Chicago, thus enabling them to handle directly new matters as they develop from time to time.

One of the plans of this sub-committee was the "Railroad Smoke Inspectors' Association of Chicago" which was organized on January 2, 1913, for the purpose of bringing about the thorough interchange of thoughts and ideas between the smoke inspectors employed by the various Chicago roads and to utilize the inspectors for the joint benefit of all lines by requiring them to report cases of emissions of dense smoke,

JOINT SMOKE INSPECTION BUREAU
OF RAILROADS OPERATING IN CHICAGO

Date_____ 191__

Inspector_____

of_____ R R noted following cases of dense smoke emission on above date.

ROAD	ENG NO	TIME FROM	TIME TO	DENSITY NO	LOCATION	REMARKS

Post Card Used by Chicago Smoke Inspectors.

whether made by locomotives of their own company or by those of any other railway coming under their notice, thus bringing about increased efficiency in this line of work. In reporting an emission on his own road, the inspector sends in a postal card to the Joint Smoke Inspection Bureau, similar to the one shown in the illustration. If the emission is on another line he sends in this card and also sends a similar one to the chief smoke inspector of the offending road.

This association has held a meeting every alternate Friday since its organization, and the co-operation secured in this manner, according to the reports, has done much in the way of reducing smoke on the part of the railways in this district. In addition to this, the records show that the number of smoke inspectors on Chicago railways have been increased from thirty-two to forty-one, making the number of locomotives in daily operation in Chicago per inspector employed, forty as against formerly fifty-two. The chairman of this association is J. H. Lewis, chief smoke inspector of the Burlington and the chairman of the executive committee is C. W. Corning, chief smoke inspector of the North Western with C. P. Burnell, chief smoke inspector of the Santa Fe as the secretary.

STORAGE BATTERY CARS ON STEAM RAILWAYS.

The electric storage battery car has been developed to such a stage that it is utilized to advantage on steam railways on which a trolley system could not be employed economically. The accompanying photograph, Figs. 1 and 2, show the exterior and interior views of a new type of car recently placed in service by the Tanana Valley R. R., a steam road at Fairbanks, Alaska.

A larger storage battery car of the Beach type equipped with Edison accumulators is shown in Fig. 3 as utilized by the Chicago Great Western R. R. This car is 49 feet 6½ inches long over drawbars, 9 feet 1 inch wide over drip rail, and 12 feet 6 inches from rail to top of ventilators. It is equipped with 220 Edison nickel-steel alkaline batteries for power and 10 cells for lighting service. These batteries are placed under the car in two compartments, strongly reinforced with structural shapes and riveted to the underframe. The batteries are special railway type, having three inches of water over the plates.

This car is equipped with four 20-horse power 75 amperes, 200 volt, 700 revolutions per minute series wound motors, a pair of motors being placed on each truck, one on each axle. The wheels are driven by a gear placed on the inside exterior of the wheel hub, the ratio of reduction being 3.5:1. There are two series parallel controllers, one on each end of the car, with four series and three parallel positions and all the power wires are carried in conduit fastened to the underframe.

The car is equipped with standard couplers, locomotive type of pilots on each end, locomotive bell and whistles, and is equipped with straight air system of air brake with motor driven compressor, having a displacement of eleven cubic feet of air per minute. The latter automatically cuts in when the pressure drops to 60 pounds and cuts out when pressure reaches 75 pounds with motorman's valves on both ends and also hand brakes on each end.

The underframe is made up entirely of structural shapes, the side sills are 6-inch channels, reinforced with 3⅝-inch long leaf yellow pine wood sills, which are mortised for the posts. At the baggage end there is an additional side sill of 6-inch channel running from the platform vestibule to the battery box for reinforcing the baggage end. The center sills are 6-inch I beams, running the entire length of the car.

The end sills are 4-inch I beams with 6-inch heavy weight channels for needle beams, one on each side of the battery box, running crosswise of the car. Additional cross sills or supports to which are bolted the wood mailing strips about every 22 inches apart and the bolsters are built up, being made of 9x1 inch and 9x3¼-inch steel with steel casting for spacers.

The battery box supports are made up of 3½x2½x½-inch angles, reinforced with 5½x⅜-inch plates of steel, with 3½x3½x⅜-inch angle braces and two 1½-inch truss rods with 1¾-inch turn buckles are connected to the frame through a steel bolster casting.

The Chicago Great Western car has an interior finish of ash and polished bronze. The side posts are 2x4½-inch ash and corner posts 3x5-inch ash, and the body is divided into three compartments, passenger, smoking and baggage. The end bulkhead door is glass panelled and swings into the passenger compartment. The glass door between passenger and smoking compartment is double swing door and protected with bronze guard rails, while the door between the baggage and smoking compartments swings into the former compartment. Both the baggage and end bulkhead doors are provided with locks and end vestibule door is equipped with double catches and keepers so that door may be kept open or closed at will.

The platform is equipped with Edwards automatic stop trap,

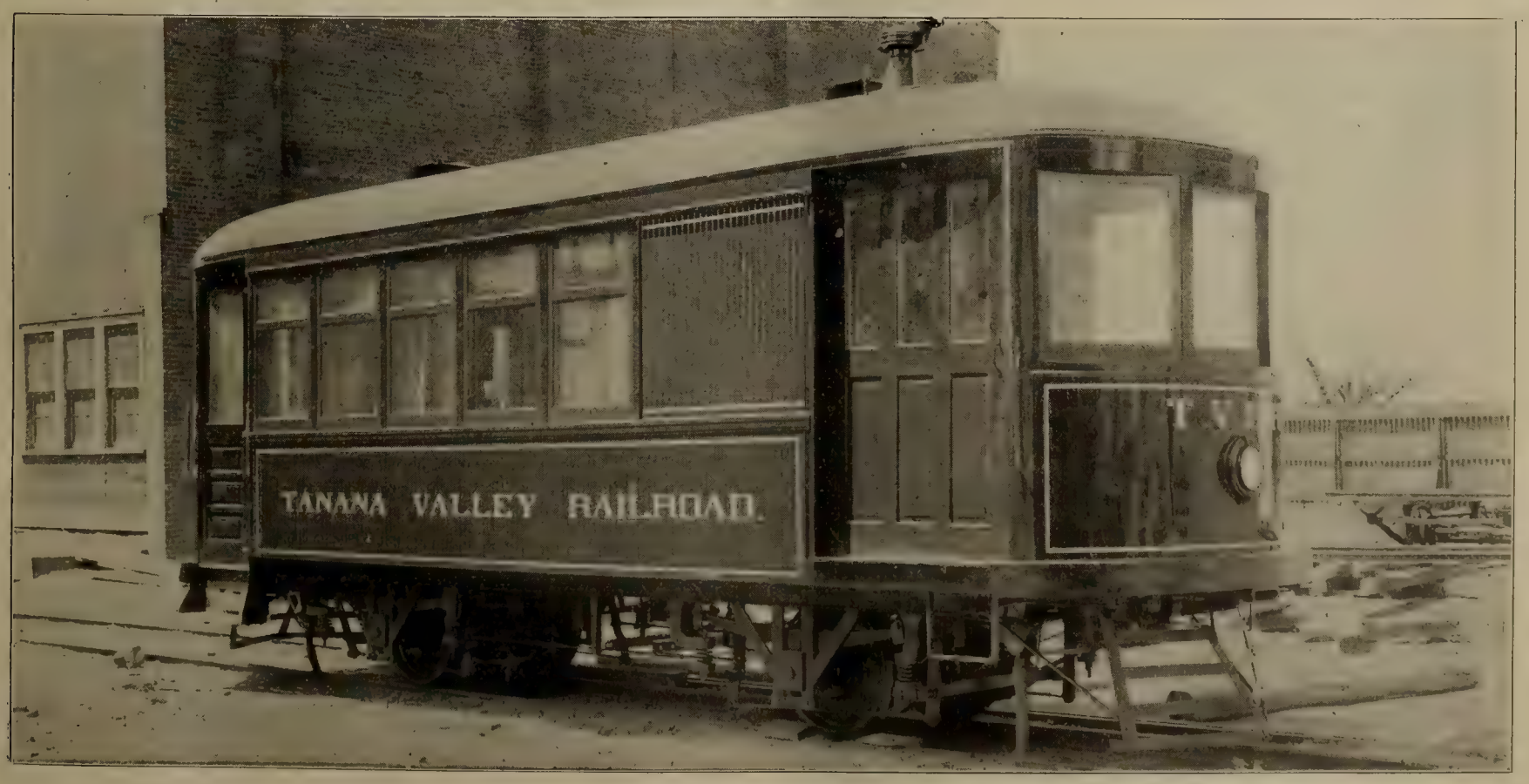


Fig. 1—Electric Storage Battery Car, Tanana Valley R. R.

Fig. 3—Electric Storage Battery Car, Chicago Great Western R. R.

covered with corrugated rubber and faced with steel angle. All side windows are equipped with drawrods rack and sash fixtures. The passenger compartment is 22 inches long with 10 cross reversible seats, seating two passengers each, two stationary cross seats for two passengers each, and two longitudinal seats with space for one and three passengers respectively. All seats are covered with woven rattan with bronze grab handles.

The smoking compartment is 5 feet 3 inches long and has four stationary cross seats for two passengers each; the total seating capacity of the car being 36 passengers. Baggage compartment is 15 feet 6 inches long with sliding doors on each side. A hot water heater is placed in this compartment with pipes for heating the other compartments. There are three natural draft ventilators (adjustable) in passenger compartment, one in the smoking, and two in the baggage compartment.

Fig. 2—Interior of Tanana Valley Storage Battery Car.

The carlines are of pressed steel with wood furring pieces, with basswood roof and composite board headlining.

The roof was first loaded, then covered with canvas and oiled, after which it was given two coats of paint. The trucks are of diamond frame type and are made up of standard structural shapes and flats. The axles are 4½ inches in diameter, having a tensile strength of 80,000 pounds per square inch and elastic limit of 40,000 pounds per square inch, an elongation of over 20 per cent and a reduction in area of 25 per cent.

The wheels are chilled iron and are free to rotate independently of each other on the stationary axle. This is accomplished by a single rigid axle upon which is pressed a nickel-steel hardened sleeve, over which two trains of rollers rotate. They in turn are held in a nickel-steel hardened raceway, pressed into the wide hub of the wheel. Truck pedestal springs are double coil, while body springs are double elliptics.

The Chicago Great Western car requires a current on level of 134 amperes, the voltage being 238 volts and the speed 36.6 miles per hour. With a load of 29.5 tons on a test run from Silver Lake, N. J., to Jersey City and return, 20 miles, the storage batteries supplied 113 ampere hours round trip for driving and 2 ampere hours for the compressor, the total current used per car mile for driving, being 5.65 ampere hours.

The watt hours required per car mile on level was 896, while two 20.37 watt hours were used per ton mile and 42.7 horsepower was developed by motors, the train resistance being 15.2 pounds per ton on level. The rated capacity of the batteries was 71,400 watt hours with a mileage capacity $= \frac{71400}{896} = 79$ miles while the normal actual output was 80,000 watt hours and the mileage capacity $= \frac{80000}{896} = 89$ miles. It is stated that the maximum output on overcharge was found to be 90,300 watt hours and the mileage capacity 100 miles.

The Baltimore & Ohio has awarded a contract to James Stewart & Co. for the construction of a grain elevator in the Calumet river district at South Chicago, to have a capacity of 875,000 bushels. The elevator will have a steel frame and be fireproof throughout, and will be erected on concrete foundations. The work house will contain 55 bins, with a capacity of 250,000 bushels, and there will be 70 storage bins with a capacity of 625,000 bushels. There will be three receiving elevators in the building, three shipping elevators, two cleaning elevators and a screening elevator. It is planned to begin work at once in order that it may be completed in time to receive this year's crop.

It is stated that the Canadian Northern will build large shops at Port Mann, B. C., to provide for the manufacture of locomotives and cars.

May Conventions

THE AIR BRAKE ASSOCIATION.

By F. M. Nellis, Secretary.

George Westinghouse and his able corps of assistants gave to the railways that wonderful safety device which bears his name, but to the Air Brake Association largely belongs the credit of establishing the highly efficient air brake service on railroads today. A retrospective view of the organization and achievements of this association, which in St. Louis will hold its twentieth annual convention, will be interesting to railway men in general.

Nearly twenty years ago a group of six air brake men from the railways in New England journeyed from Boston to St. Louis to learn more of the air brake practice of the West, it being generally conceded that railways in that section were at that time further advanced, due to the exacting requirements of mountain service, in air brake operation and systematic maintenance.

The search of these air brake men brought them to the Westinghouse Air Brake Company's instruction car which was at that time in St. Louis, and several days were spent listening to the class instructions given to railway men visiting this car in quest of helpful air brake information. Ample opportunity was afforded during these days to compare and contrast the instructions given, which did not in all respects agree with those given by the New England instructors. Criticisms and debates of the Eastern visitors and the instruction car attaches were so frequent, and sometimes so prolonged, that it was decided that the regular class work should be given up for one day and the car be given over to an exclusive meeting of the air brake experts.

It was further arranged to invite all air brake experts of the roads running into St. Louis to attend this meeting. Accordingly, telegrams were sent out, and the following day every seat in the car was occupied by an interested and eager participant in the first real air brake discussion ever attended by such a group of air brake specialists. The session extended, not only far into the night, but into the early daylight hours of the morning. So satisfactory and beneficial to all was this meeting felt to be that a unanimous vote was passed to call a meeting of air brake men and formally organize an air brake association.

A consummation of this plan resulted in an organization meeting in Pittsburgh, Pa., in 1893, and the Air Brake Association was regularly launched on a successful and useful career. A constitution was adopted which contained wide open doors as to membership. Any man having to do with air brakes in any capacity whatever was eligible to membership. The experience of all men participating in all branches of the air brake service was deemed necessary for a fully rounded out organization, which this association planned to be. This policy has proved justifiable and wise, as is attested by the successes achieved by this active organization.

Rufus F. Emery, the present treasurer of the Westinghouse Air Brake Company, was then a stenographic clerk in the Wilmerding office, and was loaned by his employers to report the organization meeting. He enjoys telling now of his futile efforts on that lively occasion to record the discussions —how he remonstrated in vain to the chairman that he was not "getting" the speeches and that the speakers should talk slower and only one at a time—and how to him now the disordered wrangle closely approached the noise of a sputtering automobile with fouled spark plugs and muffler explosions, the net result of which was that he got no report of the meeting.

However, the association "found" itself at the first annual convention in Columbus, Ohio, and was brought to a realization that it had a serious and useful mission to perform. Indiscriminate and inexperienced argument ceased, and orderly, logical debate ensued. While loyal inspectors were inclined to becloud the failure of their respective roads to give needed attention to air brake maintenance, the fact was time and again disclosed that only a few air brakes on the head end of freight trains were coupled up and used. There were very few yard testing plants. Unused brakes were "rusting out" and had to be reclaimed. Emergency applications were frequent and numerous, as were the resultant break-in-twos, flat wheels and damage to lading. Engine and train crews, yard crews, machine shop and car shop men were uninstructed, and little, if any, air brake support was forthcoming from higher railway officials, whose belief seemed to be that the air brakes were automatic in maintenance as well as in operation.

All this, and more, too, lay ahead of the Air Brake Association. Many locomotives were without driver brakes, and with few exceptions, master mechanics of that time opposed engine brakes, because of the prevailing fallacy that by their use serious harm was done the driving boxes. Tender brakes were unworthy of the name. Triple valves were scarce and brake cylinders were never taken apart for cleaning and lubrication. Oil was poured into the hose and blown, with the dust and sand accumulation, into the triple valve. All passenger equipment cars, whether heavy or light, were equipped with 10" brake cylinders; and similarly, all freight cars (though few had air brakes) carried 8" brake cylinders. Of all these wrong practices and drawbacks, the greatest, perhaps, was the lack of air brake interest by the higher railway official and the consequent unimportance of the air brake man and his recommendations.

But that was twenty years ago. The dull picture has changed to one clear-cut with a brighter coloring. Today the 50-car and 75-car freight train, running at passenger train speed, is braked from the front driving wheels of the engine to the rear wheels of the caboose. Cars are now loaded and moved three times between some points as against once twenty years ago. Much heavier passenger trains of today are now stopped in a more creditable distance than the lighter trains of twenty years ago. Flat wheels and damages to lading from brake operations have proportionately decreased. Shop repairs and terminal maintenance have vastly improved. From the small group of New Englanders and their St. Louis associates, the Air Brake Association has reached a membership of more than eleven hundred. The superintendent of motive power, when approached on an air brake matter now, will generally say: "Take it up with Jones, my General Air Brake Inspector, and he will make his recommendations to me."

While it would be unwarranted conceit for the Air Brake Association to claim all these achievements as its own exclusively, it can, nevertheless, modestly claim a generous portion as its share. But the time is not yet for credits or divisions of credits, nor for assuming the restful posture of one whose work is finished. Although much has been achieved, much yet remains to be done; and the desired gains of the future can only be secured by a tireless continuance of that incessant pounding which has characterized the past successes of the Air Brake Association, whose declared purpose has been "To obtain, by closer association of air brake men, a betterment of the air brake service on American railways."

RAILWAY STOREKEEPER'S ASSOCIATION—ITS ORIGIN AND HISTORY.

By J. P. Murphy, Secretary.

The tenth annual convention of this association will be held at the Hotel Sherman, Chicago, May 19th, 20 and 21st and the indications are that the subjects to be presented will be of unusual importance and that the largest attendance in the history of the association will be expected.

It is interesting to note the general progress that has attended the efforts of those interested in the work of caring

for the supplies purchased and used by railways. This association can well be classed as a maker of railroad history, springing up as it has from an original gathering of a handful of general storekeepers to a paid up membership of eight hundred or more, among which are representatives from China, Japan, England, Government Railways of South Africa and practically all the railroads of the United States. The field for this organization is only partially covered.

Ten years ago a multitude of minor railway officials scattered throughout the countries mentioned, practically groped along in the dark, each working out his own salvation as to methods, economy in handling and caring for supplies. Hardly any railway storekeeper at that time knew the methods of his neighbor and in fact the railway storekeeper, as such, was rare, the conditions in various territories to a large extent governing the position. In some cases the man in charge of the material reported to the master mechanic, in others to the superintendent of bridges and buildings and again to the division engineer. But few were recognized as reporting to the management which it has since developed is logically the proper channel, because the jurisdiction over all unapplied material makes it essential that the officer having this authority should report to the management who likewise is interested in the matter from all sides.

The local conditions referred to often worked a hardship to the company. At various points the materials on hand were divided as between the different departments and in many cases two or three stocks of the same article were housed at a terminal or shop point. The engineering department would have a storekeeper carrying a lot of brooms, lanterns and other common articles, and the same condition would prevail in the motive power department and again in the transportation department. The stock was divided along such rigid lines that should the mechanical department be short of brooms, they would have to buy them rather than be able to obtain them from the other department having a stock in the same vicinity. In other words, the departmental feature was carried so far regarding the stock of unapplied material that when a broom was bought for the motive power department, it was not thought possible to use it in any other department.

The general concentration of the material under a material man has obliterated all such arrangements and the practice of today is, as a result of the effort of the Storekeepers' Association, that a broom after being once purchased and paid for, belongs to the railway company and it is put into service through the storekeeper regardless of the department of service. It is absurd for the general storekeeper to report to the purchasing agent, superintendent of motive power or any other department not having general jurisdiction. It has developed in the discussion by the Association that the management prefers a double check on the purchase, and the purchasing officer as well as the man having charge of the material should be independent of each other.

The association, through its work, and principally by bringing its members together and observing the methods of their neighbors, has developed this industry to the benefit of the corporations they represent. Many of the more prominent general storekeepers of the country have been at the head of this organization since its inception and through their efforts and their broad liberal practices, the association is rounding out its tenth anniversary.

Many bright minds have been discovered through the opportunities of showing their ability and interest at these meetings. Many of them have been called to more advanced positions because of the thoroughness in which they asserted themselves at these conventions.

The call for the original meeting was sent out the latter part of January, 1904, for the meeting to convene February 16th, 1904, at the Auditorium Hotel, Chicago. The following general storekeepers responded:

N. M. Rice, A. T. & S. F., Topeka, Kans.
J. C. Morris, C. & N. W., Chicago, Ill.
T. W. Flannagan, M., St. P. & S. S. M., Minneapolis, Minn.
J. M. Taylor, Ill. Cent., Chicago, Ill.
A. E. McLeod, C. R. I. & P., Chicago, Ill.
R. E. Dickinson, S. A. L., Portsmouth, Va.
John Burke, C. O. & G., Shawnee, O. T.
Theron Higby, C., M. & St. P., Milwaukee, Wis.
W. Josselyn, B. & M., Omaha, Neb.
H. Scatchard, N. & W., Roanoke, Va.
J. H. Waterman, B. & M., Lincoln, Neb.
L. A. Williams, M. & St. L., Minneapolis, Minn.
A. C. Kilham, St. L. & S. F., Springfield, Mo.
J. P. Murphy, L. S. & M. S., Collinwood, O.

The following were represented by proxy, held by N. M. Rice, general storekeeper, A. T. & S. F. R. R.:

H. E. Ray, D. S. K., A. T. & S. F., Topeka, Kans.
Chas. O'Connor, G. S. K., D. L. & W., Scranton, Pa.
D. F. McNab, G. S. K., C. G. W., Oelwein, Ia.
W. R. Ormsby, G. S. K., S. P., San Francisco, Cal.
C. F. Balch, G. S. K., M. K. & T., Parsons, Kans.
E. S. Goodloe, D. S. K., C. & O., Richmond, Va.
H. S. Hoskinson, G. S. K., C. Ry. of N. J., Elizabethport, N. J.
W. F. Jones, G. S. K., N. Y. C., W. Albany, N. Y.

Some of the more important matters discussed by this association are—"The Standard Stock Book," "Methods of Reclaiming Materials," "Handling of Surplus Stock," "Economy in General Operation," "How to Attain the Best Methods of Caring for Materials," "Standard Classification of Materials," "Conservation of Waste," "How to Increase the Efficiency of the Store Department," "Best Method of Receiving and Passing Invoices," "Piece Work System in Handling Store House Supplies," "Handling of Requisitions."

It has been found that the handling of stationery is as essential to the duties of the general storekeeper as any other commodity and in many instances such stock has been turned over to that department. The association has maintained a standard form of proceedings and a standard form of binding the proceedings of its meetings and they are now a series of volumes becoming to any library. This instance is cited because it is characteristic of the work of a storekeeper, and while the numerous railway journals as well as railway officials have been slow to recognize their worth, the present day indicates that they are receiving the most hearty support of such journals and officers as have to do with the progress of railway institutions.

The association, to further its aims, has developed and produced the Railway Storekeeper, a little journal devoted to the interests of those having to do with the handling, care and use of unapplied materials. It is a medium through which they converse with each other, so to speak, during the eleven months of the year intervening between conventions. Especially are the members of the Association to be congratulated on their success at this time because of their individual efforts. The organization has been built up by the contribution in the way of initiation fees and annual dues paid from their salaries. A number of the larger railways having a thorough store department organization are paying the dues and expenses of their storekeepers, insisting that their men attend the convention. This is an indication of the recognition the department is receiving and from recent circulars issued by presidents and vice-presidents of railways where the department has been installed as a new thing, the credit should be cherished all the more by the individuals because it indicates the clean methods they have been pursuing during the life of this association.

THE INTERNATIONAL RAILWAY FUEL ASSOCIATION.

By C. G. Hall, Secretary-Treasurer.

The first move toward organizing the International Railway Fuel Association was made by Eugene McAuliffe in the fall of 1908, he at that time being general fuel agent of the Rock Island-Frisco Lines and after talking with two or three fuel agents of other representative lines a call was issued October 15, 1908, signed by the following: Eugene McAuliffe, chairman, general fuel agent Rock Island-Frisco Lines; R. L. France, fuel agent Southern Pacific R. R.; J. R. Rooks, fuel agent, Boston & Maine R. R.; Thos. Britt, general fuel agent, Canadian Pacific Ry.; J. H. Hibben, fuel agent Missouri, Kansas & Texas R. R.; S. L. Yerkes, fuel agent Queen & Crescent System.

The organization meeting was held at the Congress Hotel, November 20, 1908, and thirty-five members were enrolled. The growth of our membership since the organization meeting is as follows:

Organization meeting, 35; enrolled during period November 20, 1908, to date of first annual meeting, June 21, 1909, 122; enrolled during year 1909-1910, 92; enrolled during year 1910-1911, 118; enrolled during year 1911-1912, 38; enrolled during year 1912-1913, 101; total, 506 members.

Thus from a start of thirty-five members November 20, 1908, the association has grown to an organization of 506 members at the present time. The qualifications for membership as outlined in the constitution are as follows:

Active Membership.—To include officers of railways and their assistants in charge of the purchasing, inspection, scaling, distribution, handling and accounting of fuel, and men in charge of fuel test or fuel economics on railroads—active members only eligible to vote or hold office.

Associate Membership.—Shall include officials or representatives of concerns engaged in the production of fuel, either coal or oil, fuel handling, fuel-handling devices and equipment, fuel-consuming or labor saving devices. Men whose general knowledge of fuel and fuel economics might be of value to the association shall also be eligible as associate members. Associate members to have equal rights with active members in discussing all questions properly brought before the association.

The object of the association is to advance the interest of both the members and the companies with whom they are connected by the dissemination of ideas and best practices covering the purchase, inspection, scaling, distribution, handling and accounting for fuel. The association is also endeavoring to inaugurate the use of standard forms to be used by railways, covering the waybilling and accounting for company fuel, including movement from mine through coaling stations to engines and up to the monthly balance sheet, and to establish some uniform method of computing locomotive fuel consumption, enabling railroads to exchange comparative data covering this feature of operation.

Subjects, upon which papers have been prepared, presented at meetings and discussed are as follows:

First Annual Meeting, Chicago, May 21-23, 1909.

1. Difficulties Encountered in Producing Clean Coal for Locomotive Use.
2. Correct Weighing of Coal at Mines and on Railroad Track Scales; Importance of Tare Weights Being Correct; Difference in Mine and Destination Weights; Legitimate Shrinkage Allowable on Car Lots.
3. How to Successfully Burn Locomotive Fuel Coal.
4. Standard Type or Types of Coaling Station; Best Design and Most Economical Coal Chute for Handling Coal from Cars to Locomotives.
5. Briquetted Coal and Its Value as a Railroad Fuel.
6. Best Method of Accounting for Railway Fuel, Including Movement from Mine Through Coaling Station to Engines Up to Monthly Balance Sheet.

Second Annual Meeting, Chicago, May 23-26, 1910.

1. Methods of Supervision, Instruction and Encouragement in Locomotive Operation to Secure Greatest Efficiency in Fuel Consumption.
2. Kindling Locomotive Fires.
3. Methods of Purchasing Fuel with Regard to Traffic Conditions and Producers' Interests. The Relation Between the Producer and the Railroad.
4. Mechanical Preparation of Coal.
5. Standard Uniform Blank for Reporting All Items of Cost in Connection with Railroad Fuel Stations and Handling Fuel for All Types of Stations and Conditions.

Third Annual Meeting, Chatanooga, Tenn., May 15-18, 1911.

1. Fuel Investigation Under the Bureau of Mines.
2. How to Organize a Railway Fuel Department, and Its Relations to Other Departments.
3. Petroleum, Its Origin, Production and Use as Locomotive Fuel.
4. Some Results of Buying Coal Upon a Mine Run Basis.
5. The Railway Fuel Problem in Relation to Railway Operation.
6. The Testing of Locomotive Fuel.

Fourth Annual Meeting, Chicago, Ill., May 22-25, 1912.

1. Fuel as a Factor in Locomotive Capacity.
2. Standard Locomotive Fuel Performance Sheet.
3. The Use of Anthracite Coal for Locomotive Fuel.
4. Proper Method of Firing Locomotives.
5. Locomotive Drafting and Its Relation to Fuel Consumption.
6. Inspection of Fuel from the Standpoint of the Producer and Consumer.

Fifth Annual Meeting, to Be Held at Chicago, May 21-24, 1913.

1. Standard Form of Contract Covering the Purchase of Railway Fuel Coal.
2. Use of Sub-bituminous and Lignite Coal for Locomotive Fuel.
3. Location, Construction, Development and Operation of a Bituminous Coal Mine.
4. Report of Standing Committee on Firing Practice.
5. Self-Propelled Railway Passenger Cars.
6. Modern Locomotive Coaling Station. Its Design, Construction, Operation and Maintenance.
7. Scaling of Locomotive Boilers and Resultant Fuel Loss.

The paper presented at the first annual meeting entitled "How to Successfully Burn Locomotive Fuel Coal" was prepared by T. E. Adams, superintendent of motive power, Cotton Belt Route and not only enlivened the meeting at that time, but has been the source of a great deal of discussion and comment at every succeeding meeting.

The paper on "Proper Method of Firing Locomotives" at the fourth annual meeting was illustrated by moving pictures, an innovation in this line; and a number of the larger railways have purchased the moving pictures from the association since the meeting and are using these pictures in conjunction with lectures by the superintendent of locomotive operation or some other official, to educate enginemen in proper method of firing and the economical use of coal on the locomotive.

The colored plates showing internal conditions in firebox during the time of proper and improper firing have been utilized by a number of roads in their book of instructions to engineers and firemen, explaining the proper method of handling and firing locomotives.

The handling and use of fuel on railroads is so general in its relation to various departments that the membership has not been confined to any one department, but has extended from presidents to traveling engineers. The fuel cost on a single division running from two to three thousand dollars per day certainly deserves some time and thought from not only the fuel agent, fuel inspector or fuel supervisor, but from the division superintendent and master mechanic, and we want master mechanics and superintendents as members of the association.

The managements of some roads are encouraging their staff

to join the association and paying the membership, and we feel that the results to be attained justify this action on the part of the executives of all railways.

ISSUING OF REBUTTAL DEFECT CARDS.

Editor *Railway Master Mechanic*:

There are a great many rebuttal defect cards being issued today by some of our leading western railroads, and I would like to know under what rules of the M. C. B. book they are allowed to issue them, and of what use they would be if the company issuing it refused payment of the card until the defects mentioned on defect card were repaired by you. I claim that there should be no such a thing as a rebuttal defect card, that there is nothing whatever in the M. C. B. rules that will allow you to issue such a card. I also contend that there is no end to our trouble that will thus arise from such use as this of our M. C. B. defect card. If my inspector received a car at station A from one of our connections with cardable defects without noticing them, and we move that car 50, 75 or 100 miles to our interchange station B and offer that car to one of our connections there and they require us to issue a defect card and attach same to car for the cardable defects that should have been carded by delivering line at station A, can we go back and ask our delivering connection at station A to issue a rebuttal card? I claim no. Under the M. C. B. rules we cannot bill on that rebuttal card, for we did not make the repairs, and I believe that the meaning of rule 94 of the 1912 rules is very plain that we must make the repairs ourselves on our own line before we can bill on a defect card. I also claim that if the arbitration committee ever allows this to be done that there will be no end to the trouble thus arising, as we will go back for a rebuttal card every time we are forced to issue a defect card for defects that look as if they existed at time we received the card from some other connection 40 or 50 miles away, and where will it stop? I say, let the road that received the car with the cardable defects and without asking for a card from its connections, be penalized by standing the loss shown on the defect card which it issued for not having competent interchange inspectors to protect its interests at all interchange points. I believe that should the arbitration committee ever allow this to be done that they are only letting down the bars of the M. C. B. rules. I would be pleased to hear from some of the other members on the above theme.

E. T. ENGLE,
General Car Foreman, St. Louis, Rocky Mountain & Pacific Ry.

A HARMFUL MEASURE.

The so-called full crew bill, requiring a certain number of men on every freight train, is an example of how not to regulate the public service corporations.

It is also an example of how not to legislate in the eventual interest of labor.

That public service corporations should be regulated in the interest of the public welfare and for its protection, including the interest and protection of their employes, is now established. Regulation is accepted as a principle.

But if this principle is not to be discredited it must be applied with justice and good sense.

It is not so applying it to fix by statute details of administration which should be fixed by an administrative official or body. To say that every train shall have a certain crew is to fossilize in the statute a rule which before legislation could be had to correct it might become excessive, or insufficient, unnecessarily burdensome, or inadequate. The difficulty of getting laws amended or repealed needs no discussion, and in a case like this if a reduction were advisable probably organized labor would obstruct action, and if an increase were required the railroads would obstruct. Meanwhile the rigid regulation would remain imbedded in the law.

If regulation is to be really efficient it must be left to administrative officials, who can be held to account, but who also can become expert through the study of actual conditions and can develop a system of regulations elastic to meet changes of conditions.

On the face of it the full crew bill seems merely a measure to protect the public and the trainmen. This protection should be and would be given administratively, not legislatively. It is striking at the efficiency of regulation, and therefore at its existence, to ignore this distinction. No bank, no factory, no store, no farm could be run by fixed statutory regulations, and neither can a railroad.

This is not an objection based on consideration of the self-defense of railroads and those who have invested in them, although that interest deserves consideration as much as the interest of the railroad employe, the railroad patron, or the public. It is based on the consideration of efficient regulation, for if we cannot make regulation efficient we will have to give it up for something else.

In this efficiency organized labor is directly interested. It may seem desirable to secure more employment for the time being. But if this should be accomplished without reference to the needs of the service, with the results of unnecessary charges upon that service, it is against the interest not only of the railroad shareholder but of the shipper who pays the freight and of the public, including the laboring man, to whom the shipper passes on the charge.

Organized labor cannot afford to place itself in the light of favoring a rigid and ineffective system of regulation, or, on the other hand, of asking that the public pay for work which is not economically required. It should place itself firmly on the side of efficient regulation in the public interest.—*Chicago Tribune.*

B. & O. CLUB.

The B. & O. Club was organized at Atlantic City, June 17th, 1912, with the following officers: Charles F. Giles, superintendent machinery Louisville & Nashville Railroad, Louisville, president; Charles L. Sullivan, secretary Cowles-MacDowell Engineering Company, Chicago, secretary; organization committee, S. M. Dolan, American Car & Foundry Company, St. Louis, chairman; J. Snowden Bell, patent attorney, New York; A. Gordon Jones, general railway supplies, Washington, D. C.

The object of this association is "To promote friendly social relations between persons who are now or have heretofore been employed by the Baltimore & Ohio Railroad, and who are interested in the American Railway Master Mechanics or the Master Car Builders' associations, and to develop and record matters and reminiscences of historical interest relating to this railroad, etc."

The organization committee will be prepared to submit for ratification the constitution and by-laws at the next annual meeting, which will be held at Atlantic City some time during the meeting of the American Railway Master Mechanics' and the Master Car Builders' associations, June 11 to 18, 1913, and it is hoped that all present and former employees of the B. & O. who are members of either the M. M. or M. C. B. association or guests of these conventions will attend the meeting, place and time of which will be published later.

The Philadelphia & Reading has completed the plans for car repair shops and other buildings to be erected at St. Clair, Pa. The repair shop will be 100 feet wide by 600 feet in length and the machine shop 50 feet wide by 400 feet in length. The grading of the sites for the new buildings has been started.

The Southern, it is reported, will make improvements at North Birmingham, Ala., and will construct additional yard facilities which will involve an approximate expenditure of $150,000.

The Sunset-Central Lines are reported to have plants for an 18-stall roundhouse and a shop at Del Rio, Tex.

The bridge over Mill Creek at Walla Walla, Wash., has been declared unsafe by E. G. Miller, traffic manager of the Walla Walla Valley, and a new structure will probably be erected this summer.

ADJUSTMENT OF LOADS AND PREPARATION OF REPAIR CARDS.*

By W. H. Sitterly.

In presenting the matter of transfer and adjustment of loads, I do not want to convey the idea to any one present that the road which I represent is free from criticism, and it is my earnest wish that what little I contribute on this subject will be the means of reducing to a great extent the number of cars that are now shopped to have loads transferred or readjusted. Any of the data that I will present can be easily collected by any one desiring to do so by visiting any of the large yards in the Buffalo district, or any large terminal in the country.

I will grant that it is a very easy matter to gather conditions as shown in photographs, but what we should all strive for is a remedy for the condition that now exists. From my point of view I believe that it is the duty of each and every railway to educate the shippers located on their lines in the proper method of loading material both in open and closed cars. This can be done very easily by furnishing the industrial plants with a copy of the Master Car Builders' loading rules and delegating a representative of the railway, who is thoroughly familiar with the loading rules, to instruct the shipper. I have had considerable experience along this line and while I have met with some objections from the shippers, the majority, however, have shown a willingness to co-operate with the railway company in the proper loading and securement of their commodity so as to land it safely at the destination. Co-operation of the railways along these lines in a large district is absolutely necessary, and what are the demands of one road along the lines of loading, if in strict accordance with the Master Car Builders' loading rules, should be the demands of each and every railway in that district. In this manner, improper loading will be reduced to a minimum.

It is, however, absolutely necessary that the representative who is delegated to impart the information to the shipper be thoroughly conversant with the loading rules, for the reason that I have found in some cases where inspectors or other railroad representatives have insisted on the loader living up to a certain rule which did not apply to that particular load, the load being of such a nature that it would come in the category of a special load and good sound judgment only was to be used in deciding the securements necessary.

I have also found that a large number of bad loads originate at stations where there is no inspector located and the agent passes judgment on the load, and he, not being thoroughly conversant with the rules, his judgment is poor, where if he would take the matter up with his superior and a car inspector or other representative thoroughly conversant with the rules sent to the point where the car is being loaded, in order to instruct the shipper, the load would reach its destination much sooner and pass by a repair yard instead of into it for readjustment or possibly transfer.

It has also been found that at points, same as mentioned above, loads are unevenly distributed in the cars through the ignorance of the loader, and also due to the agent not understanding the absolute necessity for proper distribution. A number of derailments have resulted from this cause.

In going over a large number of cars where it was necessary to transfer the lading, I regret to state that the condition of the car showed very plainly that it was in a bad physical condition when it was loaded. The car should have been placed on the repair track for repairs instead of being placed at the warehouse or teaming siding to receive a load. In a large district such as this, it is surprising the number of foreign cars that are held in the shop and transportation yards awaiting disposition from the owners on acount of their physical condition, and I can safely say, without fear of contradiction, that 90 per cent of these cars started away from the loading point carrying a load and it was necessary to shop the cars and transfer the lading, the cars never reaching the destination intended with the load.

During the past year I have had occasion to watch the physical condition of the box car, which I must say, is deplorable. Box cars or house cars are placed on the shop tracks, and end sheathing and siding renewed over posts and braces which are split, and in a great many instances posts decayed at the base. As soon as the car receives a load it bulges out at the sides and ends, and in a great many instances claims results from the loss of commodity. I refer particularly to the time of the year when the demand is great for box cars for moving grain out of a lake port.

From August 15th to September 15th, 1912, inclusive, at one of the large terminals, the following number of cars were shopped on account of apparent improper loading, causing bulged doors, shifted loads, etc., and instead of showing the names of the roads I have used a numeral to represent the roads:

Road	Total Cars	Total Days Delay	Per Diem Expense	Cost Mtl. and Labor	Total Cost	Avrg. Cost Mtl. and Labor	Average Cost Mtl. and Labor Per Day	Avrg. Cars Per Day	Avrg. No. Days Delay Per Car
1	13	36	$ 10.15	$ 18.02	$ 28.17	$1.39	$2.17	.4	3
2	296	395	106.05	296.18	402.23	1.00	1.35	10	1.3
3	39	45	15.75	34.68	50.43	.89	1.30	1	1.2
4	67	110	38.50	44.12	82.62	.66	1.23	2.2	2
5	104	205	61.95	211.54	273.49	2.03	2.63	3.5	2
6	11	42	11.90	18.12	30.02	1.65	2.73	.3	4
7	10	8	2.80	4.14	6.94	.41	.70	.3	1
8	20	22	6.65	13.68	20.33	.68	1.01	.6	1.1
9	18	18	4.20	18.06	22.26	1.00	1.23	.6	1
10	4	4	1.40	3.42	4.82	.85	1.20	.1	1
Total	582	885	$259.35	$661.96	$921.31	$1.14	$1.62	19	1.6

In compiling the above figures, there was one road from which I was unable to procure any data.

A large number of these cars passed over the initial road without the doors showing any signs of distress, i. e., bulged out, but at some points, or points along the line, these cars received service shocks, which are incident to all cars, and the load shifted little by little until it reached the district mentioned. The initial road does not bear the expense of the cost of re-arrangement or transfer. The burden is placed on the delivering line, the delivering line being the second road to handle the car, and the party making the adjustment or transfer against the delivering line is the third road handling the car, and, of course, in a territory working under an agreement, the same as is in effect at Buffalo, the delivering line passes the car on in order to expedite the movement of freight, which to my mind is not expediting it because it does not make any difference whether the car lays two days in "A" road's yard for transfer or adjustment, or whether it lays in "B" road's yard for the two days.

The figures that I have given you in this statement are correct in every detail and were obtained from an actual check.

In going over the changes in the rules as recommended by the committee of the Central Railway Club, you will note that they have recommended that the cost for transfer or adjustment be levied on the initial road. We hope that the arbitration committee will accept this recommendation, or make some provision to assess the initial line with the cost of transfer or adjustment where they are responsible.

I trust that a year hence, by your hearty co-operation, we will be able to say that our equipment is in a better physical condition when given to the shippers to load, and also that our industrial plants are in hearty accord with the loading rules. I wish to impress upon every one to be sure that we are giving to the shippers the proper interpretation of the rules, and that we are not working any hardship on them.

The proper preparation of repair cards and defect cards is essential from a billing standpoint and the amount of labor

* Extracts of a paper presented before the Central Railway Club following the discussion on the Master Car Builders' rules of interchange.

necessary and the promptness with which bills can be rendered depends much on the accuracy of a foreman car repairs, piece work and car inspector. Incorrect car numbers and initials is an item which causes considerable annoyance, and unnecessary labor and expense.

I inquired from our motive power clerk some time ago as to just what this item meant, and he outlined to me the following course which a billing repair card would take: After reaching his office the bill is prepared, checked, listed, and forwarded to the auditor's office for further record, etc., and in turn is forwarded to the road billed against. Car record office is called upon to certify to correctness of initials, numbers, dates, etc., but if it cannot do so, reports accordingly. The reported owners, however, assuming that wrong car number has been given, passes bill for payment, debits its expenses with a corresponding amount, prepares voucher, and forwards same to treasurer of road rendering bill, which takes record, endorses voucher, deposits it to its credit, and eventually, through the usual channel, it reaches issuing road, where it is entered and filed.

The road rendering bill is then communicated with by letter and requested to give correct number. By investigation it is found that wrong initials were given on repair card. This information is transmitted to road billed against, and as there is little likelihood of another bill being rendered against that road in the near future, so that proper credit can be allowed, a letter of authority is issued to countercharge for the amount involved. Recipient of counterbilling authority proceeds to prepare bill to reimburse its expenses, forwards same to proper officer of the road billed against, which checks authority with records, passes bill for payment, forwards to auditor, where voucher is prepared and forwarded to road rendering bill, which takes record, endorses voucher, deposits it to its credit, and eventually, through usual channel, it reaches issuing road, where it is entered and filed.

The repair card had, of course, been referred back to the foreman for investigation, through the usual channel, and he had, upon consulting a book record kept by his man, found the correct initials of the car which had been given repairs. He corrects stub, and declares he cannot advise cause of the error.

The corrected card is then used as authority for rendering bill against car owner, expenses are credited, bill forwarded to car owners, who find card checks with the record. Bill is checked and passed for payment, voucher issued, forwarded to treasurer of road rendering bill, who takes record of payment, endorses voucher, deposits it to credit of his road, and eventually, through usual channel, reaches issuing road, where it is entered and filed.

If party making up repair card would have used several seconds additional time to compare number and initials of car as written on repair card with number and initials of car, the time lost in correspondence could have been more profitably employed in legitimate work and no loss would have occurred on account of stationery and postage used in straightening out the matter.

The importance of comparing initials and numbers of cars as written on repair card with those shown on cars, or in authentic records, should be impressed on all concerned so that the matter of wrong numbers and wrong initials will be reduced to a minimum.

In going over this matter, I find that it is necessary to visit the small outlying points and render as much assistance to the inspector at that point as is possible, for the reason that he is not in the close vicinity of a large shop where much information and instructions can be given to him by his superior, and I have always found the men at these points anxious for whatever information can be given them. Besides the wrong initials and numbers on repair cards, there are other items which, if not properly stated on, or omitted from, the repair card, billing repair card and record repair card, results in the holding up of a large number of bills and is the cause of endless correspondence, and this can be remedied by a thorough study of the Master Car Builders' Rules of Interchange. If we consult these rules from time to time it will be found that they will be the means of keeping us out of considerable annoyance and trouble.

I would particularly call your attention to Rule 6, which makes it necessary, when road making partial repairs of defects on a car which are covered by a defect card, to cross off on the original card the defects repaired, and a copy of the card, together with the bill with the defects which were not repaired crossed off, will be sufficient authority to bill. This is an item which in a great many cases causes trouble. I would also call your attention to Rule 9, which covers M. C. B. couplers, or parts thereof, removed and replaced. You will note that in the recommendations for changes in the rules your committee has recommended that the name of the coupler be added to this rule for the reason that this information is necessary, as the charges and credits depend on whether a different make of coupler was applied.

This rule also shows the information that is necessary to be placed on repair card when wheels and axles are removed and replaced, also journal bearings removed and replaced; metal brake beams or parts thereof removed and replaced; brake shoes applied; type of triple valve R. & R., also when triple valve or cylinder is cleaned, the initial of road and date of last previous cleaning must be shown. If necessary to remove a load to make repairs as specified in Rule 107, it must be plainly stated.

I believe that if those who have to do with the making up of repair cards and defect cards, also slipping defect cards, make a closer study of the rules, a large amount of money will be saved to their railroad company.

I made a canvass of this situation over the Grand Division with which I am connected, some little time ago, and found that our men were willing and anxious to co-operate, but for some reason or other in some instances the M. C. B. rules of interchange were not consulted as frequently as they should have been. I believe that the preparation of repair cards should be placed in the hands of one who is thoroughly conversant with the M. C. B. rules of interchange and the construction of a car. In this manner, repair cards will be properly prepared and the company performing the work, if owner's defect, will be properly reimbursed for all labor and material which they have placed on the foreign car.

FREIGHT CAR REPAIRS.

By J. C. Fritts, M. C. B., D. L. & W. R. R.

One of the largest of the many items that enter into the expense incident to railroad operation is repairs to freight train cars, and as this expense in sum total is increasing from year to year, it has been claimed in various statements published that this item has increased in proportion far in excess to the work performed by such cars, the work referred to being considered only from a standpoint of tons carried per car. This, it would seem, is not correct; although it is obviously of interest to know whether the duty performed by freight car equipment is increasing in the same proportion as the expense incident to the maintenance.

It is the practice of railroad statisticians to prepare figures comparing the cost of maintaining freight car equipment from year to year either on a unit basis or per-car-mile basis, and it is questionable in either instance if it can be determined from such figures whether the duty performed warrants the increased cost.

The unit basis of comparison is of little value. A railroad may spend an average of $50 per car for maintenance of freight train cars one year, and the following year spend $60 per car, still the equipment may be performing service that would warrant the increased cost.

The cost-per-mile basis is misleading, inasmuch as no distinction is made as to the capacity of cars in service or train tonnage.

There are many features that influence the expense incident to car maintenance, and when comparative figures are prepared for the information of those interested, it would seem desirable to show more than the mere cost per unit per annum or per car-mile, and that in addition to such figures the duty performed should be given, so that reasons for the increased costs would be apparent.

A 25-ton car will be much less expensive to maintain than a 50-ton car, and roads that make a practice of handling short trains should maintain their equipment cheaper than those where long and heavily laden trains are the rule. Therefore, information relating to the duty performed should be as comprehensible as is consistent with existing conditions.

It is realized that if all conditions that enter into the operation of freight train cars are considered in preparing comparative figures the result would be so complicated that it would be so complicated that it would be difficult to understand, but it is believed that the three principal items that enter into the

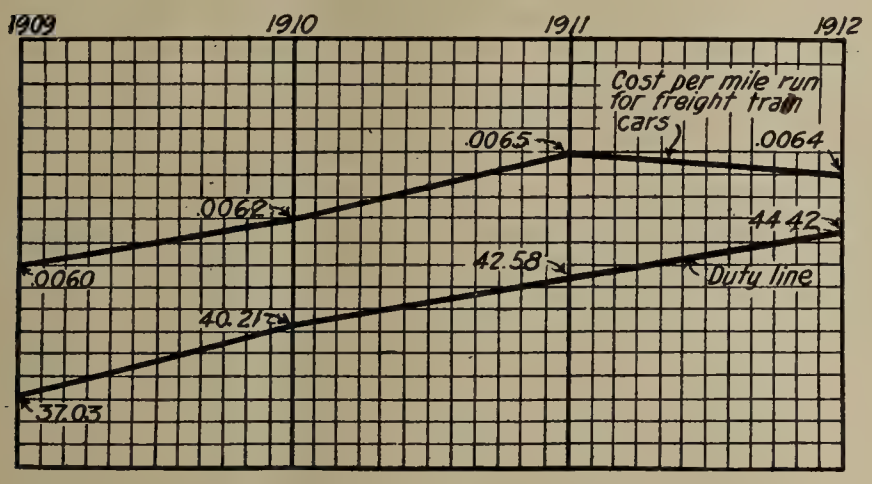


Diagram Showing Comparative Cost and Duty of Freight Cars, D. L. & W. R. R.

matter of duty performed by our equipment should be considered, i. e., car mileage, car capacity and tons per train.

The diagram herewith indicates the cost per mile per car for maintenance for calendar years 1909 to 1912, and also the duty performed by the equipment during the same period, on the Delaware, Lackawanna & Western Railway.

The formula used in obtaining the figures shown on the "Duty Line" is as follows: Average mileage per car × average capacity per car × average train tons ÷ 4,000,000.* The result shows that, while the cost per car-mile for repairs has increased 6.6 per cent the duty performed by the car equipment has increased in same period 19.9 per cent.

* The figure 4,000,000 used in this formula has no significance, it merely being used to reduce the result to a figure more easily handled.

The Harriman Lines have ordered 201 passenger cars from the Pullman Co. The Union Pacific will receive 5 baggage and 20 chair cars; Oregon Short Line, 6 postal cars, 5 baggage cars, 1 diner and 5 chair cars; Oregon-Washington & Naviation Co., 4 postal cars, 4 baggage cars, 15 coaches and 1 observation car; Southern Pacific Co., 6 postal cars, 8 baggage, 4 diners, 15 coaches, 4 observation cars and 4 buffet and baggage cars; Central Pacific, 4 postal cars, 5 baggage cars, 10 coaches, 2 diners, 2 observation and 2 buffet and baggage cars; Arizona Eastern, 3 postal cars, 1 baggage car and 6 coaches; Galveston, Harrisburg & San Antonio, 7 baggage, 17 coaches and 12 chair cars; Houston & Texas Central, 5 baggage and 5 chair cars; Texas & New Orleans, 3 chair cars; Chicago & Alton, 2 diners and 3 postal cars; Houston, East & West Texas, 3 coaches.

The Havana Central, it is reported, has ordered 50 general service gondola cars from the Pressed Steel Car Co.

MOST POWERFUL ELECTRIC LOCOMOTIVES IN THE WORLD, N. Y. C. & H. R. R. R.

Ten-passenger electric locomotives of the most powerful type ever built are to be placed in commission by the New York Central & Hudson River R. R. out of New York City. A very exhaustive series of tests and trial runs of an experimental locomotive of this type was recently made on the Harlem division. This locomotive was immediately put in service on the electrified section of the New York Terminal and a contract was awarded the General Electric Company for nine additional locomotives of the same design, which are now under construction.

The electric locomotives in service in the terminal previous to the introduction of the new engine weighed approximately 115 tons each. While the new locomotives are considerably lighter, weighing 100 tons, they are much more powerful, are provided with ample forced air ventilation and designed with a view to continuous high speed service. All the 100-ton weight is carried on motor-driven axles, while the former locomotives have but 70 tons weight on the driving wheels.

The new electric engines will exert sufficient tractive effort to haul a train weighing 1,000 tons at 60 miles per hour. In regular service they have a capacity for developing 1,400 horsepower continuously and can develop as high as 5,000 horsepower for short periods. Compared with existing types of electric locomotives, this machine has greater capacity and higher efficiency than any other high speed electric locomotive ever constructed. With all, its total weight, weight on the drivers and "dead" weight, is less than that of its nearest competitor.

Briefly, the history of the development of the New York Central latest type of 600 volt, direct current, passenger, high speed electric locomotive recounts a notable achievement in designing skill. The original New York Central electric locomotives had guiding wheels in the form of a pony truck with 28,000 pounds on the axle. There were four driving wheels, each carrying the armature of a direct current, bipolar, gearless motor. To improve the riding qualities of this pioneer express electric locomotive, a guiding bogie truck having two axles was substituted for the pony truck. A further development in a subsequent type was to increase the distance between the guiding trucks and the rigid wheel base. The riding qualities were improved, but at a loss in the mechanical efficiency of the locomotive; for about 40 tons of surplus weight had been added and were being carried by the bogie trucks for the sole purpose of guiding the locomotive. The addition of motors to the bogie trucks and the elimination of this ineffective weight was the next step, so that every pound of the locomotive weight would be instrumental in producing adhesion and tractive effort. A still greater separation of the fixed wheel base and the buiding trucks lengthened the machine so as to necessitate constructing the running gear in two halves with a spring-connected articulated joint between the frames. Thus has been evolved the "new high speed marvel."

At the present time the New York Central & Hudson River is operating forty-seven electric locomotives in the New York Terminal service. Of these, thirty-five were built in 1906 and twelve in 1908. They are all of the 115-ton 484 type and are each equipped with four GE-84 bipolar, gearless motors. The new electric locomotive adopted by the company is likewise a bipolar gearless design, but it is equipped with eight GE-89 motors and is designated type 4444. Each motor is approximately three-fourths the capacity of the GE-84 motor used on the previous engines, making the aggregate capacity of the motors on the locomotive approximately 50 per cent greater than before and affording approximately 25 per cent higher speed.

In general, the locomotive may be described as having an articulated frame with bogie guiding trucks at each end. The cab containing the engineer's compartment and that for the

New York Central Electric Locomotive.

operating mechanism is swung between the two parts of the frame on the center pins. Each section is equipped with two two-axle trucks having a driving motor mounted on each axle. These cannot be distinguished as main driving or leading trucks, since all the axles are driving axles; but they are termed for clearness rigid trucks and swivel trucks respectfully.

The rigid truck is built up of heavy steel castings, the side frames being of a truss pattern with heavy top and bottom members and pedestal tie bars. The end frames and center cross frames are steel castings securely bolted to the side frames and supporting the magnet poles. The magnetic circuit of each truck consists of the armatures mounted on the axles, the magnet poles carried on the end frames, the side frames and an additional magnet bar forming a path in parallel with the side frames. The whole weight of the truck is carried on semi-elliptic and coil springs resting on the journal boxes and equalized together. The main frame or backbone of the locomotive is a box girder built of 10-in. channels with ¼-in. top and bottom plates. It is approximately 10 in. deep by 36 in. in width and 22 ft. in length. The frame is bolted to the top member of the rigid truck, and extends forward over the center plate of the leading truck and backward to the heavy hinge which connects the two halves of the frame. The main frame carries in its top plate the center pin which supports the weight of the operating cab. All these center pins are hollow and serve as air passages, the main box girder frame acting as a distributing reservoir for the air delivered from the blower in the upper cab through the upper center pins and conducting it to the eight motors below.

The construction of the swivel or leading truck is similar to that of the rigid truck, except that it carries a center pin and is connected to the main frame through this center pin instead of being bolted rigidly to it.

This type of design affords a long, flexible wheel base with eight axles, but restricts the length of any rigid portion to not more than 6 ft. 6 in. All the axles are equipped with motors, but the magnetic circuit for each truck or pair of motors is self-contained and relates only to the two axles in that truck.

The cab, carried on the two center pins as stated, has its weight distributed between the two halves of the locomotive frame. It is the box type, 35 ft. in length and 10 ft. wide. The interior is divided into three sections. A motorman's compartment is located at either end and contains the motorman's seat, controller, air brake, valves, bell and whistle rope handles, and such parts of the control apparatus as have to be within reach of the operating engineer. In the central section of the cab are the air compressors, blowers, contractors and rheostats, grouped so that they are conveniently accessible for inspection and repair, and separated from the direct reach or attention of the operating engineer. The advantage of this arrangement is that it removes from the sight of the engineer running apparatus which might serve to distract his attention from the actual work of handling the locomotive and which can be inspected and attended to by his assistant. This general type of construction leaves a fairly long platform on either end of the locomotive. Access to the cab is obtained through doors opening onto the platform.

The principal data and important dimensions applying to the locomotive are the following:

Length inside of knuckles	55 ft. 2 in.
Length over cab	33 ft.
Height over cab	12 ft. 8 in.
Height with trolley down	14 ft. 6 in.
Width over all	10 ft.
Total wheel base	45 ft. 7 in.
Rigid wheel base	5 ft. and 6 ft. 6 in.
Total weight	200,000 lbs.
Weight per axle	25,000 lbs.
Dead weight per axle	6,395 lbs.

Taking up the specific features of the electrical equipment, the eight GE-89 bipolar, gearless motors each have the armature mounted directly on the axle. The field poles are carried on the truck frame, which forms the magnetic circuit. There are four independent magnetic circuits in the locomotive corresponding to the four trucks. The magnetic flux path on each truck passes in series through the fields and armature of one motor, through the center transom and the fields and armature of the second motor to the end frame, and then returns to the starting point through the two side frames and a reinforcing magnet bar lying parallel with the frames.

The motor is practically enclosed, and the field coils are waterproofed and armored. Each field coil is wound in a brass shell, the windings being in two decks of flat ribbon copper laid side by side. The outside turn is covered with insulation and an armor of sheet steel is clamped over it, filling the space between the sides of the shell in such a way as to protect the windings from water or mechanical injury. End shields are provided for each motor, which render it dust tight and as nearly water tight as is possible in any motor designed with necessary outlets for forced ventilation.

Each motor at its one hour rating has a capacity of 325 amperes on 600 volts or a continuous rating of 260 amperes on 600 volts under forced ventilation. For the complete equipment of eight motors, this corresponds to a capacity of 13,500 pounds, tractive effort at 54 miles per hour for the one hour rating, and 10,000 pounds tractive effort at 60 miles per hour continuously.

The motors are electrically connected permanently in parallel in pairs, and the pairs can be connected in three combinations: viz., series, series-parallel and parallel. They are insulated for 1,200 volts, so that if at any future time it should be desired to operate the locomotive on 1,200 volts the pairs of motors could be changed from parallel to series connections and the same speeds and control combinations obtained as on 600 volts.

The control equipment on the locomotive is the well-known Sprague-General Electric Type M and is designed to operate the eight motors connected in the three combinations: series, series-parallel and parallel. The external regulating resistance,

divided into four parts, is directly connected, each part to a pair of motors permanently grouped in parallel. The pairs of motors with their respective resistances are connected all in series on the first point of the controller. The resistance is varied through eight points on the controller and finally short-circuited on the ninth or running point. The pairs are then operated similarly in series-parallel with all resistance cut out on the seventeenth point. Finally all of the pairs are connected in parallel with the twenty-fourth step a running point. This provides a control with nine steps series, eight steps series-parallel and seven steps parallel.

The transition between series and series-parallel is effected without opening the motor-circuit, and there is no appreciable reduction in tractive effort during the change. The smooth transition between points, both rheostatic and transitional, permits motor operation close to the slipping point of the wheels. The locomotive weight on the drivers is so proportioned that the motors operate safely up to the slipping point, which serves as a limit to prevent overloading the motors. The transition between all four pairs of motors in series to series-parallel is accomplished by short-circuiting two of the pairs of motors during the instant of transfer. The transition between series-parallel and parallel is effected by means of the standard bridge method.

The motor cutout switches are connected so that any pair of motors may be cut out of circuit. The locomotive will operate when a pair of motors is cut out with two groupings of the motors, the first with two pairs of motors in series and the second with three pairs of motors in parallel.

The protection of the locomotive against short circuits is very complete. All main fuse boxes are of the copper ribbon type, fitted with hinged covers to facilitate fuse renewals. The box is provided with a very effective magnetic blowout, which is energized by the current passing through the fuse. The main fuse boxes are located as near as possible to the overhead trolley and to the third rail shoes in order to protect the wiring circuits near the source of supply. Each pair of motors is locally protected by a fuse box. The main switch is provided with a blowout so that heavy currents can be opened without damage.

An ammeter is located at each engineer's position and records the current in the circuit of one pair of motors. The ammeter and air gauges are illuminated by a gauge light connected in the headlight circuit, so that the headlight switch turns on simultaneously the headlight and the gauge light at the same end of the locomotive.

The main motor rheostats are formed of cast iron grids mounted in a frame and insulated in mica. The rheostat boxes are assembled in the monitor deck of the locomotive.

Current is collected by eight underrunning third rail shoes, or by two overhead trolleys when on gaps on the third rail. The overhead trolleys are the pantograph type and are pneumatically operated. They can be put into service from either engineer's position by a foot-operated valve. The trolley is designed for intermittent use and is therefore arranged to be held in a raised position only while the valve is held open by the engineer's foot.

The headlights are the incandescent type with parabolic reflectors 16 inches in diameter. The interior illumination of the cab is provided by ten incandescent lamps arranged in two circuits, two lamps being located in each engineer's cab and the balance in the central compartment. In each lamp circuit is a portable lamp with extension cord 25 feet long. One lamp switch is located in each engineer's compartment, so that from either end of the locomotive the lamps can be controlled in that compartment, as well as half of the lamps in the central compartment.

Electric heaters are placed in the two engineer's compartments. The heaters are a standard electric car type, fitted with especially heavy outside covers to protect them from the mechanical injuries to which they are exposed in locomotive service.

The blower set provided for ventilating the driving motors is located in the central compartment. The blower has a capacity of 24,000 cubic feet of air per minute and is driven by a series wound motor of the railway type.

The air compressor is the CP-26 type. It is a two-stage motor driven compressor with a piston displacement of 100 cubic feet of air per minute when pumping against a tank pressure of 135 pounds per square inch. The air is taken from the interior of the central compartment through a screen, which prevents the entrance of particles of dust. The compressed air, in passing from the low pressure to the high pressure cylinder, is conducted through radiating pipes under the platform of the main cab. This reduces the temperature of the air and allows condensation of moisture before entering the high pressure cylinder. From the high pressure cylinder it is delivered into a series of air reservoirs. There are four of these, each 16 inches by 90 inches. They are located under the floor of the cab and connected in series, which affords a further opportunity for radiation and condensation.

Leach type L double pneumatic sanders are provided. The sander valves are located within convenient reach of the engineer's seat, and valves and sand boxes are arranged for sanding the track in front of the leading wheels when running in either direction. The bells are fitted with Sampson automatic bell ringers. All wiring is drawn through conduits and is carefully protected from mechanical injury.

End View, Electric Locomotive, N. Y. C. & H. R. R. R.

BARNEY & SMITH CAR CO.

The shops of the Barney & Smith Car Co., of Dayton, Ohio, have been cleaned out and are practically in normal shape again after the temporary cessation of operations caused by the recent flood. The losses of the company have been greatly exaggerated by the newspapers although an accurate estimate of the loss cannot as yet be prepared. The portion of the large lumber stock which floated away, was mostly found within a short distance of the plant, and has been reclaimed and repiled.

The company has all its power plants in operation, is now at work on the various car orders on hand, and expect within a few days to be running full force on these orders as usual. None of the cars under construction at the plant when the flood occurred were ruined, or a total loss. They are being put in good shape and completed, and will be shipped within a short time.

FACTS WITH REFERENCE TO THE CIRCULATION OF WATER IN LOCOMOTIVE BOILERS.*

The motion of the water within a locomotive boiler in response to the energy transmitted to it in the form of heat, is known to have an important bearing on the up-keep and life of the boiler. It is known also that the water always rises from the heating-surface, and that upward currents thus stimulated must be compensated for by downward currents in other portions of the boiler. But the downward currents are secondary and are probably less stable and less direct than the initial currents which rise. In the complicated passages of a locomotive boiler, these secondary currents may take various directions and move with various velocities. Their strength and direction have been the subject of much loose speculation.

The paucity of facts available concerning the movement of water about the firebox of a locomotive boiler led to an early determination on the part of the Jacobs-Shupert company to undertake an experimental study of the matter. In the development of its plans George L. Fowler was retained to conduct the proposed investigation. Mr. Fowler entered upon the work with enthusiasm. He skillfully devised a method of procedure and he designed and secured the construction of special apparatus which he afterward used at the testing laboratory in Coatesville.

In preparation for Mr. Fowler's work, the water-leg, both of the Jacobs-Shupert boiler and of the radial-stay boiler, was drilled with fifteen holes regularly located at points chosen for exploration. The holes were filled when not in use by a 1-inch pipe plug, Fig. 3. It is to be regretted that in the time allowed for the work actual observations could only be taken at holes 3, 7, 8, and 12 of the Jacobs-Shupert boiler and at holes 3, 8, and 12 of the radial-stay boiler. By the methods employed by Mr. Fowler, and fully described by him in the report which follows, an exploring tube with an opening at right angles to its axis was connected with a suitable manometer gage. This tube was inserted at the point to be investigated. By turning the exploring tube on its axis and observing the indications of its gage, the direction of the flow could be ascertained. The tube was inserted through a stuffing-box and its initial end could be made to occupy any position along the line of its axis between the firebox sheet and the outside sheet of the boiler. The results as to direction are shown graphically, and as to velocity, both graphically and numerically, by Fig. 1. Concerning the inconsistencies which are here apparent, Mr. Fowler calls attention to the fact that "the records of the angle of flow must not be taken as positive or fixed." The

Fig. 3—Location of Holes for Circulation Test.

observations for direction of flow were not taken simultaneously with those for velocity. The fact is, as Mr. Fowler himself makes clear, that the work he has done is to be accepted only as the beginning of a solution of a very complicated problem.

It should be very clear from these statements that no useful result will follow an attempt to compare values obtained from the Jacobs-Shupert boiler with corresponding values from the radial-stay boiler. Neither as to direction nor velocity of flow are the values given absolute or comparable. Since all circulation is in response to the application of heat, the velocity of flow and of some points in the boiler, the direction also must depend upon the rate of power at which the boiler is operating. Since, also, the introduction of cold water must tend to suppress upward currents and stimulate downward currents, a full interpretation of any set of values must specify whether the injector is in operation or otherwise. Observations to determine the precise characteristics of the circulation, to possess comparative value, must be taken when all of these controlling conditions are maintained. Mr. Fowler's observations upon the radial-stay boiler were made during the progress of efficiency tests. Nos. B—405—R, B—406—R, B—407—R, B—502—R, the results of which are elsewhere reported. His observations on the Jacobs-Shupert boiler were made after the boiler had been transferred to the site of the low-water tests, where it was especially operated for his work. The fact that Mr. Fowler makes no attempt to connect the results he observed with the rate of evaporation or with any other factor which could be accepted as a measure of the activity of the process within the boiler, is an indication that he regarded the data which it was possible for him to secure in the time allotted, as insufficient for such a purpose.

But notwithstanding the limitations which must be placed about them, Mr. Fowler's results constitute a distinct contribution to the sum of knowledge and are of tremendous significance. They show, for example, almost a complete absence of any fore and aft movement of the water. His conclusion upon this point is as follows:

"I think that if this matter were to be examined to a finality, it would be found that there is a regular slow movement from front to back, broken throughout the whole course by violent agitation and innumerable cross currents, but that in no place are these currents torrential nor is the steam movement itself very rapid."

That is, Mr. Fowler finds no evidence to show that the water at the bottom of the boiler is pushing backward and in the upper part forward. His observations seem to sustain the very rational assumption that enough water passes back from the barrel to the water-legs of the boiler to make good that which the firebox evaporates, and no more. Since the firebox evaporates from 30 to 50 per cent of the water handled by the boiler, a similar percentage of the total feed must, in the case of the Jacobs-Shupert boiler,

*From the report by W. F. M. Goss on the comparative tests of the Jacobs-Shupert and radial-stay boilers.

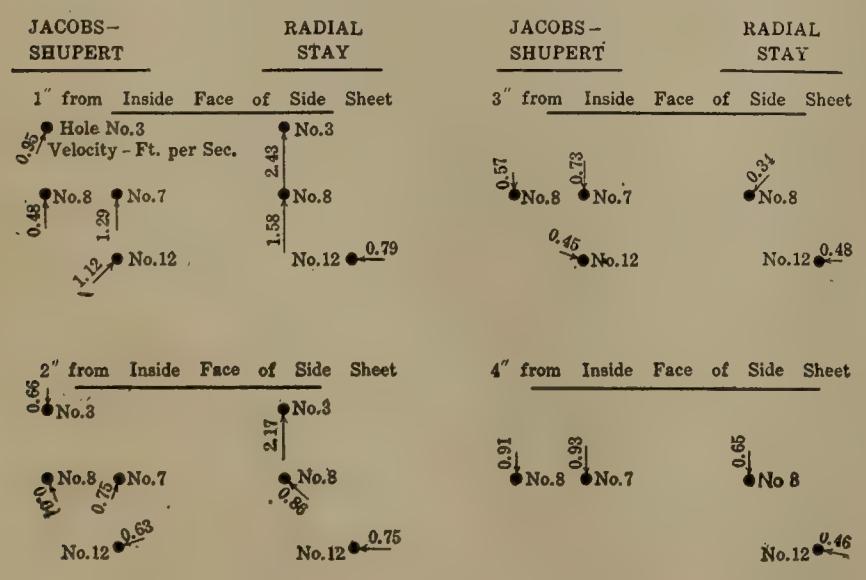


Fig. 1—Diagram Showing Velocity in Feet per Second in Different Portions of Water Leg.

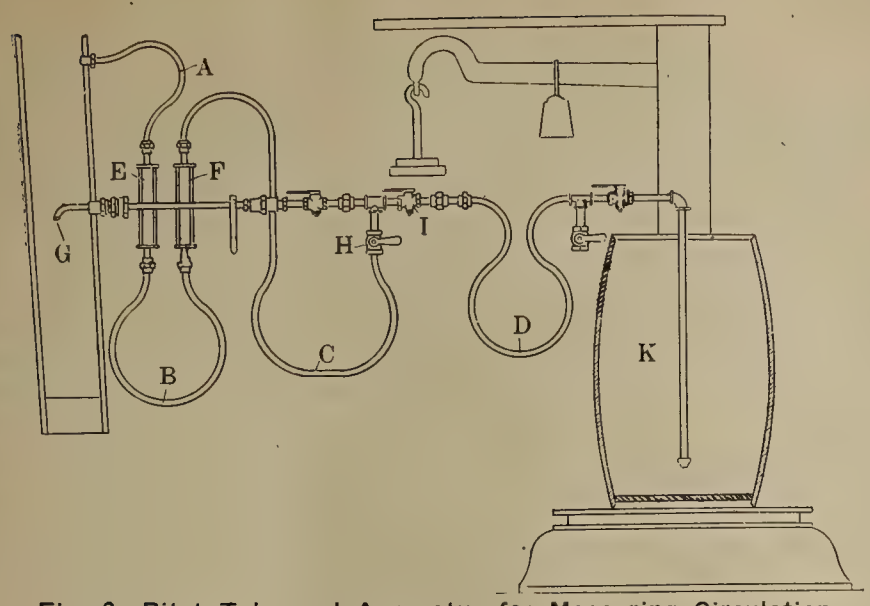


Fig. 2—Pitot Tube and Apparatus for Measuring Circulation.

find its way through the ports in the forward stay-sheet. Some of this water is evaporated before the second stay-sheet is reached. With the passage of each section, the backward flow diminishes until at the last stay-sheet only enough passes to supply that which the last section evaporates. Obviously, an aggregate port area of 1⅔ square feet is quite sufficient to pass from 30 to 50 per cent of the water which the injector delivers through a 2-inch or a 2½-inch pipe.

The conclusion that the fore and aft movement of water in a locomotive boiler is no greater than is necessary to convey from the front of the boiler, where it is delivered, that portion of the feed which is to be evaporated by the heating-surface which is farther back, is amply confirmed by the experience gained in running the evaporative tests of Series A. It will be remembered that in these tests, both the Jacobs-Shupert boiler and the radial-stay boiler were fitted with a water-tight partition, absolutely closing off the barrel of the boiler from the firebox end. In this case, whatever circulation there was in the barrel could only involve barrel water, and whatever circulation there was in the firebox end could only involve the water of that end. Obviously, there was no chance here for the longitudinal movement of water, and yet, under these conditions, not the least difficulty was experienced with either boiler in working the rate of evaporation up to more than 10 pounds of water per foot of heating-surface per hour, that is, to a rate of power which upon the road would be regarded as normal.

All this should make clear the fact that the ports in the stay-sheets of the Jacobs-Shupert boiler have a very minor function to perform. Not only are they, as now designed, entirely sufficient, but the thermodynamic performance of the boiler could not suffer in any way if they were reduced to a small percentage of their present area.

The report of Mr. George L. Fowler is as follows:

Report of G. L. Fowler.

The apparatus used for this purpose was designed to measure the velocity and direction of flow as well as the quality of the mass of the liquid at different points of the water-leg of the firebox. It is shown diagrammatically in the accompanying print. The principle of its operation is that of measuring the impact of the flow of the mass in the water-leg upon the mouth of a Pitot tube, by means of the elevation of a liquid heavier than water in a U-tube, and afterward determining the quality of the liquid, that is, the proportions of contained water and steam by means of samples led off into a barrel calorimeter. The Pitot tubes were inserted in the firebox at the points where it was desired to make the measurements, and could be moved to and fro through suitable stuffing boxes so that the opening could be placed at any point between the two sheets. At the same time it was revolvable so as to be turned to face in any direction. The construction of the apparatus in detail was as follows:

The Pitot tube G, Fig. 2, was inserted in the water-leg and was connected by means of the flexible pipe C with the top of a water-glass F. From the bottom of the water-glass F another flexible tube B ran to the bottom of the water-glass E; while from the top of the water-glass E, a third flexible tube, A, ran to a point in the firebox below the water-line. The flexible pipe B and the two water-glasses formed a U-tube which was filled to the center of the glasses with tetrachloride of carbon that was colored red and whose specific gravity is exactly 1.6. It was evident that, with connections to the boiler as shown, the liquid will stand at the same height in each of the two glasses so long as the pressure above the tetrachloride of carbon in each leg remains the same, but if the pressure on either leg exceeds that of the other, the tetrachloride in the leg of the higher pressure will be correspondingly depressed. This increase of pressure was secured by turning the Pitot tube, and when it faced directly into the stream, it would produce the greatest pressure at the top of the glass F, with a corresponding depression of the tetrachloride in that leg.

For convenience of entering the boiler fifteen holes were drilled in the side of the firebox. They were in three rows, five in a row and numbered, for the sake of identification, as shown in the accompanying print, Fig. 3. The Pitot tubes were used; those holes not occupied being plugged.

After a reading had been taken, the valve H was closed and the valve I opened. This cut the pressure off from the top of the water-glass F, and allowed the mixture of steam and water entering the Pitot tube to flow into the water, partially filling the barrel calorimeter K, when from the temperature ranges before and after the admission of the liquid from the boiler together with the pressure existing at the time as read from the steam gage, it was possible to determine the percentage of steam and water entering into the mixture as it existed at the mouth of the Pitot tube in the water-leg. From this the specific gravity of the mass could be calculated.

Then with the head produced by the difference in the levels of the tetrachloride of carbon and the specific gravity of the liquid whose impact caused that difference of level, the velocity of the liquid can be calculated.

The heat (B. t. u.) given is for that above 32 degrees Fahr. The column headed "Angle of Flow," indicates the observed angle at which the mass was moving at the time of the observation. It is measured in the direction of the movement of the hands of a watch starting with 0 for the vertical downward movement. Then 90 degrees would be horizontally from the front to the back; 180 degrees vertically upward, and 270 degrees horizontally from the rear to the front.

The "Specific Gravity of the Mass" denotes the specific gravity of the combined mass of steam and water.

The "Velocity of the Mass" is the velocity which a mass of the corresponding specific gravity would have to have in order, by its impact on the mouth of the Pitot tube, to cause the difference in the level of the tetrachloride as observed.

The "Velocity of the Steam," given in the last column, is the velocity that steam of the pressure existing in the boiler at the time of the observation would have to have in order to cause the observed difference in the levels of the tetrachloride.

These velocities are calculated on the basis of the elevation of a mass whose specific gravity is 0.6, for this reason. The specific gravity of the tetrachloride is 1.6. The 1 is

DATE	TIME	NO. OF HOLE	DISTANCE FROM INSIDE SHEET, INCHES	HEIGHT OF LIQUID IN U-TUBE, INCHES	WATER		CALORIMETER		FROM BOILER			ANGLE OF FLOW	BOILER PRESSURE LBS.	PERCENTAGE OF STEAM IN MASS	SPECIFIC GRAVITY OF MASS	VELOCITY OF MASS IN FT. PER SECOND	VELOCITY OF STEAM IN FT. PER SECOND
					WEIGHT LBS.	TEMP. FAHR.	WEIGHT LBS.	TEMP. FAHR.	WEIGHT OF WATER LBS.	TOTAL B. T. U.	B. T. U. PER LB. WATER						
June 3	A.M.	8	1	1	400 5	78	440.0	114	39.5	19,478	493	180	200	15.7	.850	1.92	20.65
"	"	8	2	1/8	431.5	82	460.0	106	29.5	13,940	472	147	220	12.4	.895	.67	7.00
"	"	12	1	1/4	404 0	82	448.0	112½	44.0	18,064	411	90	190	6.4	.928	.93	10.49
"	"	12	2½	1/8	416.0	83	454.0	114	38.0	17,950	473	90	185	14.0	.847	.69	7.51
"	"	8	3½	1/8	394.5	84½	445.0	129	50.5	25,105	497	55	220	15.5	.873	.68	7.00
"	2.54 P.M.	8	1	3/8	332.0	86	376.5	110	44.5	13,842	405	180	180	6.0	.980	1.10	13.17
"	3.26 "	8	2	3/8	316.5	88	356.0	118	39.5	15,104	382	152	170	3.7	.967	1.11	13.50
June 4	9.13 A.M.	8	1	7/8	358.0	78	386.5	100½	28.5	11,418	400	180	205	4.5	.954	1.71	19.00
"	10.33 "	12	1	1/8	376.0	83	416.5	112½	40.5	16,418	405	90	205	5.1	.949	.65	7.19
"	11.00 "	12	2	3/32	341.0	86	396.0	128	55.0	22,572	410	90	205	5.7	.943	.80	8.79
"	11.20 "	12	3	1/16	348.0	88	400.0	128½	52.0	22,024	435	90	210	8.4	.921	.48	5.02
"	11.44 "	12	4	1/16	336.0	88	388.0	128½	52.0	21,538	414	93	210	5.9	.943	.46	5.02
"	1.30 P.M.	8	2	5/16	339.5	86	388.0	123	48.5	19,594	404	175	220	4.3	.980	.79	11.12
"	1.54 "	8	3	0	342.0	88	386.0	122½	44.0	18,245	415	...	215	5.8	.947	.00	0.00
"	2.12 "	8	4	1/8	341.5	88	383.5	122	42.0	17,743	422	0	205	7.1	.930	.65	19.00
June 5	8.45 A.M.	3	1	1½–2	318.0	76	350.0	106	32.0	13,316	416	180	215	6.0	.944	2.25 2.60	24.35 28.12
"	9.41 "	3	2	1¼–1½	320.0	82	347.5	104	27.5	10,375	377	180	155	4.2	.935	2.07 2.26	25.67 28.13

Details of Observations of Circulation in Radial-Stay Boiler.

balanced by the superincumbent weight of water in each leg of the U-tube, leaving only the .6 to be moved by the impact on the Pitot tube.

In handling the apparatus and making the observations here recorded, the differences in level of the tetrachloride were first observed. Then water and steam were blown through the piping, leading to the calorimeter, sufficient to heat it, after which it was turned into the barrel for the measurement of its heat values.

The records of the angles of flow must not be taken as positive and fixed. The figures given are for the approximate average inclination of the flow. As a matter of fact, it shows every evidence of constant variation, sometimes through angles approximately 45 degrees for the higher velocities, and this together with other general indications have led me to the opinion that there is much agitation in a boiler, with comparatively little circulation or progressive movement of the water. I think that if the matter were to be examined to a finality it would be found that there is a regular slow movement from front to back, broken throughout the whole course by violent agitation, and innumerable cross currents, but that in no place are these currents torrential nor is the steam movement itself very rapid, while in some places there is a true circulation, that is, the water follows a definite path returning to a previous position. An example of this is found in the tests at hole 8 of the radial-stay boiler on June 4. At one inch from the inside sheet there was an upward flow of 1.71 feet per second; at two inches the flow was still nearly vertical; at three inches there was a neutral point at which no movement could be detected; while, at four inches or near the outer sheet, there was a vertical movement downward. The same thing is observed with the Jacobs-Shupert firebox at holes 7 and 8, but without the indication of a neutral zone devoid of flow.

There are some peculiarities in the observations that I cannot attempt to account for because of the limited data. For example, in the observation at hole 12 of the radial-stay boiler, the three records of the third, show a constantly increasing percentage of steam in the mixture from the inner sheet to the outer. This is checked by the observations on the fourth, except that the one at four inches from the sheet, which is farther out than that of the third, shows a falling off as the outer sheet is approached. This same condition, though not so markedly, appears in the Jacobs-Shupert boiler at hole 7.

As for the general character of the water movement, there is, in the radial-stay boiler an entire absence, so far

DATE	TIME	NO. OF HOLE	DISTANCE FROM INSIDE SHEET, INCHES	HEIGHT OF LIQUID IN U-TUBE, INCHES	WATER		CALORIMETER		FROM BOILER			ANGLE OF FLOW	BOILER PRESSURE LBS.	PERCENTAGE OF STEAM IN MASS	SPECIFIC GRAVITY OF MASS	VELOCITY OF MASS IN FT. PER SECOND	VELOCITY OF STEAM IN FT. PER SECOND
					WEIGHT LBS.	TEMP. FAHR.	WEIGHT LBS.	TEMP. FAHR.	WEIGHT OF WATER LBS.	TOTAL B. T. U	B. T. U. PER LB. WATER						
June 7	3.50 P.M.	8	1	1/4	331.0	77	373.0	110	42.0	18,926	451	180	170	12.8	843	.48	11.02
"	4.15 "	8	2	1/8	299.0	84	328.0	108½	29.0	11,032	380	160	205	2.1	.976	.64	7.18
"	4.30 "	8	3	3/32	328.0	76	364.5	108	36.5	14,876	408	0	202	5.8	.940	.57	5.05
"	4.40 "	8	4	1/4	359.5	77½	402.0	109	42.5	16,530	389	0	210	2.5	.975	.91	10.09
"	5.10 "	12	1	3/8	344.0	81	381.5	112	37.5	15,501	413	225	225	5.2	.954	1.12	11.94
"	5.30 "	12	2	1/8	343.5	78	398.0	115	54.5	19,760	363	75	125	4.4	.912	.68	8.93
"	5 45 "	12	3	1/16	322.5	84	370.0	123	47.5	19,370	408	315	225	4.5	.961	.45	4.87
June 8	10.45 A.M	7	1	1/2	344.0	65	406.0	116	62.0	24,898	401	180	220	3.9	.964	1.29	13.32
"	11.05 "	7	2	3/16	350.0	84	395.0	118½	45.0	18,307	418	190	220	5.9	.947	.79	8.53
"	11.23 "	7	3	5/32	349.5	89	386.0	116	36.5	14,583	400	0	215	4.0	.962	.73	7.87
"	12.00 "	7	4	1/4	338.5	86½	381.5	120	43.0	17,467	406	0	200	4.5	.952	.93	14.60
"	12.22 "	3	1	1/4	352.0	85	384.5	113	32.5	14,211	437	190	190	9.5	.897	.95	14.85
"	12.45 "	3	2	1/8	344.5	94	374.5	118	30.0	12,708	423	0	190	7.8	.913	.66	10.89
"	.....	7	4	3/16	....	....	....	....	....	....	....	0	....	....	....	....	....

Details of Observations of Circulation in Jacobs-Shupert Boiler.

as my observations went, of eddy or reverse currents. The movement is either vertical or back from front to rear, whereas in the Jacobs-Shupert firebox, with the general movement the same, there was one hole where the movement was from the rear to the front, evidently due to eddies set up by the stay-plates.

In calculating these velocities corresponding to the heights, I have taken it that these heights or differences of level vary as the impinging mass and that the squares of the velocities vary inversely as the mass.

Incidental to this, I observed that a change in the rate of steam flow through the exhausting pipes would have its effect on the velocity of the currents in the water-leg of the firebox. The opening of the safety-valve, for example, would increase the speed at once. While when the pressure was being raised, the water seemed quite stagnant.

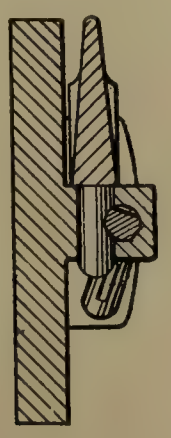
In order to ascertain the likelihood of there being a straight flow of cold water from the front to the rear over the top of the foundation ring, a thermometer was placed at the back lower corner of the Jacobs-Shupert firebox on the eighth, when being driven as already indicated and using feed water at a temperature of about 70 degrees Fahr. When the boiler was at work under 215 pounds' pressure the observed temperature at this point was 380 degrees Fahr., or only 13 degrees below the boiling point at that pressure. This indicating either a circulation through hot portions of the boiler before reaching the back end of the water-leg, or an agitation of the water enroute and its mingling with quantities of steam or hot water by which its temperature was raised.

The tests cannot be regarded as conclusive because of their meagerness, but they indicate that neither the water nor steam velocities of a locomotive firebox are high, and that the opening in the stay-plates of the Jacobs-Shupert firebox are quite sufficient to admit the water in ample quantities to all parts of the water-leg.

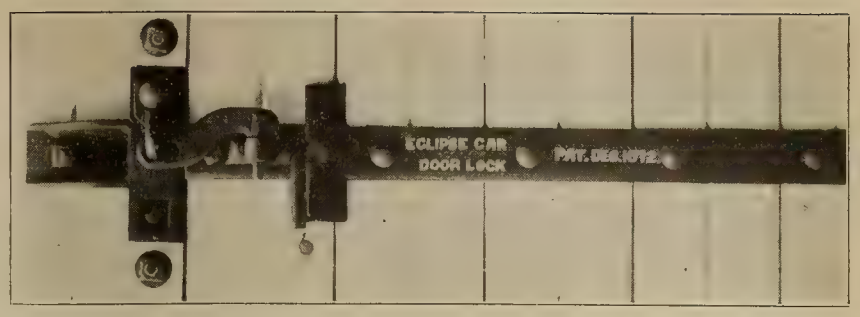
Finally, I wish to suggest that many of the seeming inconsistencies of these observations may be attributed to the interval of time between them. This ran for fifteen minutes to forty-five minutes in which there was ample time and opportunity for such changes to occur in direction of flow and rate of evaporation as to fully account for the actual changes observed.

CAR DOOR LOCK.

A combination door lock, stop and tie plate has been invented and patented by Charles L. Alden, foreman car repairs of the New York Central & Hudson River at Albany, N. Y., details of which may be seen by referring to the illustrations. The essential feature of the lock is the latch and the locking pin arrangement. The latch is pivoted to the door stop in the door post. The pin or nose of the latch has a semicircular recess on one side into which the locking pin turns when the handle is pushed downward. When this handle is in a horizontal position, a recess in the locking pin is presented which alines with one side of the hole of the keeper into which the nose of the latch fits. Thus, when the door is closed, the locking pin handle is held in a horizontal position, the latch pin dropped into the keeper and the handle turned down, thus locking the latch. A slot in the locking pin handle and in the adjoining plate allows the fastening of a car seal. The tie strap upon which the locking bolt is fastened, covers several of the door sections.



Section Through Latch and Keeper.



Combination Doorstop and Lock.

BRONZE JOURNAL BEARINGS.

There is perhaps no single question in machine design that has attracted more attention than that of *bearings*. This is due largely to the extreme importance of this topic. Bearings are a necessary element in almost every kind and description of machine. The essence of a machine is the execution of a movement. Ordinarily these movements are made under pressure or some other condition that introduces friction. Now, friction involves the wear and tear of the contacting parts; and consequently two adverse things are brought into play. The greater the wear and tear—which parallels the friction—the greater the loss of power in operating the machine; and the greater the wear and tear, the greater will be the deformation of the parts. Power loss and deformation are two important debits which every designer and every one responsible for operation economy must seek to diminish to a minimum. We can not reduce them to zero. But modern investigations have shown that large reductions may be made. Ball bearings and roller bearings represent one line of development. No doubt they have come to stay and are becoming securely entrenched in the machinery world. There is, however, a limitation to their use growing out of the excessive reduction of the area of support. The older style of bearing having generous areas of support are not only still prevalent, but promise to remain indefinitely as occupants of the field which their characteristics adapt them to hold. The efforts to improve and develop this type have been persistent and successful.

The development and improvement in connection with *plain bearings* has been along three lines: (1) design; (2) lubrication; and (3) materials of the parts. Such bearings involve a *slide* of metal upon metal. It was found out long ago that if both the contacting metals were the same that the friction would generally be greater than where they were different. Thus, cast iron sliding upon cast iron would develop more friction than cast iron sliding upon brass. The underlying reason is thought to be as follows: All metals, whether polished or not, do not present perfectly smooth surfaces: there are minute, not to say microscopic, depressions scattered everywhere. Further, it is not unreasonale to suppose that the non-depressed portions lying between the thickly scattered depressions are of similar size and form as compared with the depressions. Assuming the foregoing account to be correct, one will be prepared to understand that when two surfaces of the *same* material press against each other, there will be a greater amount of interlocking than would be the case where the surfaces belong to different metals having different structures. Cast iron rubs hard on cast iron because the protruding particles fit well into the intervening depressions. For the time being, this theory or hypothesis may very well be accepted. We have in it the explanation why the practice is so general of using a journal of one material and a box of another.

But even under the best conditions, dry metal sliding on dry

metal will produce enormous friction and great wear. It is ancient history that this can be wonderfully reduced by the use of an intervening liquid—the lubricant.

Now the design of a bearing has to take account of the foregoing things. Smith & Marx in their recent work on "Machine Design" enumerate four items in design—(1) provision must be made to take care of possible rupture or an excessive yielding; (2) provision for permanence of form; (3) provision for the retention of the lubricant; and (4) provision against overheating. Let it be said at once that in order to cover requirements (2) and (4), account must be taken of the material which enters into the making of the boxes.

It is easy enough to secure a metal which will supply a sufficient difference of structure to the material in the journal to make an easy-running box. Almost any kind of babbitt metal will cover this single requirement. But if heavy loads per square inch of projected bearing have to be supported, then a fairly high degree of compressive strength becomes essential. And so, it is necessary in the case of car wheel boxes to employ a stiffer material. But another reason enters here. Car wheel and similar journals are subject to such severe conditions that it is very necessary that the material of the boxes have a fairly high melting point. Otherwise, the bearing would be frequently liable to deformation, not to say destruction, from avoidable and unavoidable overheating. It has, accordingly, become quite general to construct bearings subject to heavy duty from some alloy of copper. It would seem as if this metal provided the difference of structure essential or advisable for pretty much all kinds of machinery. Almost nowhere are journals made of copper—they may occasionally be of brass, however. Pretty much everywhere where iron or steel journals have to support heavy loads or otherwise undergo severe service, the usual practice is to use a tin alloy of copper (bronze) or a zinc alloy of copper (brass). But copper itself is subject to damage from the oxygen of the atmosphere when raised to certain high temperatures. Phosphorus has been found to be a corrective of this. This peculiar element has a tremendous avidity for oxygen; and this is the quality that makes it valuable in connection with copper. If phosphorus is present under favorable conditions when copper is heated, the former substance will keep the oxygen busy and thus save the copper from the bad effects. But phosphorus is a difficult substance to manage. The pure material is probably never used. The case is somewhat similar to that of manganese—the substance which acts as a deoxidizer in connection with steel manufacture. Both substances—phosphorus and manganese—are applied in practice in the form of a combination. Thus, manganese is added to the molten steel that comes from the Bessemer converter in the form of an alloy of manganese and iron. So with phosphorus. When the good offices of this substance are required in connection with the purification of the liquid bronze or brass that is to go into a bearing, the pure chemical is not employed; but some complex material containing phosphorus is used instead. Thus an alloy called "Metallic Phosphoro," made by the New Era Mfg. Co., Kalamazoo, Mich., is a specially prepared metallic substance containing phosphorus. This material acts as a flux and deoxidizing agent in connection with the casting of bronze and brass mixtures.

One of the first things to note is the fact, discovered by experience, that bearing boxes and other bronze castings must be poured from the first melting in which the above mentioned flux is employed, if the best results are to be obtained. It will not do to pour an ingot of the purified bronze and then remelt this ingot later on when casting the article wanted. It is not clear just what takes place, or why it is that the remelting has a damaging effect. But the fact itself is well ascertained.

It is probable that this agent operates pretty much as vanadium and titanium are supposed to do in connection with steel—that is as a scavenger, seeking out and somehow practically eliminating the hindrances to the union of molecules, etc. It is claimed that this material operates to produce a close fine-grained casting increasing the strength. The amount required is inconsiderable as may be seen by noting three formulas below. These bronzes are adapted for railway car journal bearings. It will be observed that lead forms one of the constituents of these mixtures. In fact, it forms 8 per cent of each bronze. It is said that lead is necessary to a good quality of anti-friction bronze. Ordinarily, lead and copper do not unite very well. But the influence of Metallic Phosphoro is said to overcome this reluctance to a thoroughgoing union. It will be noted that the sum of the weights of tin and Metallic Phosphoro is constant throughout all three formulas. Bronze A has the greatest *crushing resistance;* while C has the greatest *tensile strength.* Bronze B surpasses in elastic quality.

Bronze Formulas for Journal Boxes Subjected to Heavy Service.

	A	B	C
	Parts by weight	Parts by weight	Parts by weight
Copper	80	80	80
Tin	10	10½	11
Lead	8	8	8
Metallic Phosphoro	2	1½	1

In order to provide a comparison between these railway bronzes and a bronze used on the state railways in Prussia, let us consider two analyses of the latter. The analyses were made from samples taken from bearing castings. (See *Untersuchungen über Lagermetalle Rotguss.* By Profs. E. Heyn and O. Bauer. Mitteilungen aus dem Königliches Materialprüfungsamt, 1911, Bd. 29, S. 66.)

Prussian Railway Bearing Bronze.

	Analysis No. 1	Analysis No. 2
	Per cent.	Per cent.
Tin	15.24	15.00
Arsenic	0.19	0.18
Lead	0.08	0.07
Copper	84.39	84.57
Iron	0.09	....
Zinc	0.09	0.10
Sulphur	trace	trace
Total	100.08	99.92

It will be seen that this is essentially a copper-tin-zinc alloy (84:15:1), the other constituents appearing only as impurities.

For American railway service, the bronze in common use has a copper content ranging from 80 to 90 pounds of copper per hundredweight of alloy. The balance is a phosphor tin. It will be noted that no place is given to lead. This omission permits, so it seems, a coarseness of grain that is imperfectly suited to form a bearing surface. Now lead does give a smooth surface, as will be understood when it is considered that it is the base of most babbit metals. It is to be expected, then, that lead will promote fineness of grain in a bronze, provided it can be properly incorporated into the alloy. And such is the case.

It has already been remarked that anti-friction bronze made with Metallic Phosphoro should be cast in its final form at the first melting. This deterioration by repetition of melting probably extends pretty generally to all bronzes. Frequently, the chemical analysis will fail to detect any substantial change, although such a change has actually taken place. An example of this is given in the investigations of Heyn and Bauer referred to above. A copper-tin bronze made by the formula 85:15 is supposed to be remelted and to suffer a moderate oxidation. That is to say 0.54 per cent of oxygen becomes united with 2 parts of the tin, forming thus 2.54 per cent of tin oxide. The bronze will be considerably altered, because the tin oxide remains in the alloy. If a chemical analysis be now made, the result will be but little different from what it was before for the reason that the percentages of the metallic constituents of the alloy are but slightly altered by the small weight of oxygen absorbed. In fact, we may calculate the new analysis as follows:

Tin .....14.92 per cent
Copper .....84.54 per cent
Oxygen ..... 0.54 per cent

Usually in such analyses the oxygen would be entirely lost sight

of and chemistry would not inform us of the alteration in the structure due to the presence of 2.526 per cent (2.54 ÷ 100.54) of tin oxide. It would seem then that it would be a good safe rule never to permit bearing boxes to be cast from remelted bronze.

CARBORUNDUM AND ALOXITE*

Although Carborundum is a versatile abrasive which cuts many different substances quickly and freely, it is too hard and too brittle for steel. Steel is hard, close-grained, strong, and tough. Therefore, the abrasive which can grind steel successfully must surpass it in hardness, compactness, strength, and toughness. Aloxite is made to fulfill these requirements. Moreover, it cuts without heating the work or becoming heated itself.

Carborundum.

Carborundum is the trade name of an abrasive which is made by heating a mixture of sand, coke, sawdust, and salt in an electric furnace. It is a definite chemical compound formed from the silicon of the sand and the carbon of which the coke is composed. It may be considered either a silicide of carbon with the chemical symbol CSi, or a carbide of silicon with the chemical symbol SiC. Carborundum was not known in the crystalline form until the electric furnace was devised. However, a compound having the same chemical composition had been prepared and described by several chemists. This substance, which was green, soft, and non-crystalline, had no commercial value whatever and was simply a chemical curiosity. To form crystals of Carborundum a heat of tremendous intensity was required, and it was the electric furnace which made possible the production of this high temperature. It was simply a question of fusing electricity as a fuel and thereby producing a temperature which could not be attained by any known heating agent.

In 1891 crystalline Carborundum was first prepared in a small electric furnace at Monongahela City, Pennsylvania. This fact is interesting historically, because Carborundum was one of the first substances produced in the electric furnace. The furnace used by E. G. Acheson in this experiment was a small iron bowl which was connected to one terminal of the dynamo. The bowl was filled with a mixture of clay and carbon. Into this mass was plunged a carbon rod, which, in turn, was connected to the other terminal of the dynamo. After the current had been passed through the mixture for a certain time the connection was broken and the carbon rod was removed from the mass. Adhering to the end were small crystals of some substance which sparkled like a diamond. Experiment showed that these sparkling bits were very hard and cut glass very easily. People who like myths and fairy tales say that the investigator hoped to form diamonds by this method. If this was his aim, he failed, but not by a wide margin, for the new substance was almost as hard as the diamond although not so suitable as a gem. The story goes that the new substance was called Carborundum because the experimenter thought it was a compound of carbon and aluminum oxide which is a constituent of clay. When crystalline aluminum oxide is found in nature it is called corundum. So Carborundum is a new word created from the two words, carbon and corundum.

The iron bowl was soon discarded for a furnace which was constructed of bricks and which was ten inches long, four inches wide, and four inches deep. In furnaces of this size, the company produced fifty pounds of Carborundum in 1891, the first year of its existence. A large part of this output was sold for gem polishing and valve grinding. The present-day furnaces are 30 feet long, 12 feet wide, and 10 feet deep, and represent a thirty-nine thousand fold increase in capacity over the furnaces used in 1891. There are twenty-one furnaces in the furnace department, which are in continuous operation for twenty-four hours a day and seven days a week. The production of Carborundum this year will be approximately 15,000,000 pounds.

The furnaces are built with concrete end walls which contain the electrode terminals and with side walls composed of several sectional units of fire-brick set in iron frames. This construction facilitates the loading and discharging of the furnaces.

In charging the furnace, the mixture of sand, powdered coke, sawdust, and salt is fed into the furnace from an overhead conveyor until the furnace is half filled. Then a core of carbon is built through the furnace from end to end, the upper half of the furnace sides are set in place and the furnace filled heaping full of charge. The furnaces are known as resistance furnaces and the heating effect is due to the transformation of electrical energy into heat when the electricity encounters resistance as it flows through the conducting medium. The furnace ends are cooled by a water-circulating system to protect them from the intense heat. Under the influence of this high temperature, the sand and carbon combine while carbon monoxide gas is given off and works its way to the outside through channels made by the burned sawdust which is added to the charge to make it porous and so allow the gas to escape freely. If sawdust were not added, the gas would collect in the interior of the furnace until a sufficient pressure was generated to enable it to force it way to the surface. This would mean upheavals of the furnace charge. However, with the sawdust, the reaction proceeds quietly and peacefully and the gas reaches the surface, where it burns with the blue flame like that noticed when a fresh supply of coal is put on the fire. During the run, the furnace is wreathed in short, darting blue flames, sometimes tinged with yellow color from the burning salt, and looks like the fiery furnace it really is. The salt is added because it forms volatile compounds with impurities which are found in small amounts in the ingredients of the furnace mix. This improves the quality of the Carborundum. The furnace is designed throughout to withstand high temperatures and to allow free escape of the gases given off during the chemical reaction in which Carborundum is formed.

At the points where the heat is most intense two interesting changes take place. First, carbon is transformed into graphite; second, the Carborundum is decomposed into its constituents, silicon and carbon. The silicon vaporizes and leaves the "graphite skeleton of the Carborundum crystals." Because these two changes do take place, the length of the furnace run must be regulated. Experiments have shown the best results are obtained by a run of thirty-six hours. During this time enough electrical energy is consumed to operate an arc light continuously day and night for twelve years, or to operate one sixteen-candle-power carbon incandescent lamp for 220 years.

At the conclusion of the run, the electric current is broken and the furnace is allowed to cool. Then it is seen that the charge has shrunk appreciably, due to the sawdust burning out and to the loss of volume which the charge undergoes during the formation of the Carborundum. When the furnace has cooled sufficiently, the sidewalls are removed and the dismantling begun. The top crust is scraped off and the layer of "fire sand" exposed. This "fire sand" is a compound of silicon, carbon, and oxygen, and represents an intermediate step in the formation of Carborundum. It is of course, formed at a lower temperature than Carborundum. Beneath the fire sand is the Carborundum, forming a huge ring around the core. In contact with the core a thin, irregular ring of graphite is found. A cross-section of the furnace dismantled would show the fire sand, Carborundum, and graphite, arranged in concentric rings around the core. Each one of these rings represents a zone of temperature which decreases in intensity from the core outward. In each run the average yield of Carborundum is about nine tons.

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* From the Abrasive Age.

The lumps of Carborundum crystals are loaded into iron carts and trundled across the yard from the furnaces to the crushing department.

Such is the process by which Carborundum is created. The crystals are then crushed, purified with acid, washed, dried, graded into twenty-one grits by sieving, mixed with bonding material and formed into wheels or sharpening stones, fired or baked in kilns, finished and tested. All of these processes require time. Six weeks after the Carborundum crystals leave the furnace they come to the shipping room incorporated into a grinding wheel and ready to go forth, "the right wheel in the right place."

Aloxite.

Aloxite is the trade name for a steel-cutting abrasive, which consists essentially of aluminum oxide. Like Carborundum, it is a product of the electric furnace and is made by heating an ore containing this oxide with certain ingredients which are added to remove the impurities. As the ore comes to the furnace department, it contains aluminum oxide, iron oxide, silica, and several minerals. The object of the furnace process is to free the aluminum oxide of all these substances. The ore is crushed, mixed with known amount of carbon to aid in the purification, and is then ready to undergo the refining process in the electric furnace.

The furnace is a box-like crucible with detachable sides, and is lined with fire-clay. The current is led in through two huge carbon electrodes which are suspended in the furnace and between which an awe-inspiring arc flashes. The Aloxite furnace is, therefore, an arc furnace, while Carborundum is produced in a furnace of the resistance type. The mixture is fed in until a gigantic pig of Aloxite weighing several tons is formed. By feeding the charge directly between the electrodes, it is subjected to a temperature of maximum intensity. The temperature of the arc has never been determined with any degree of certainty, but some experts in high temperature measurements believe it will reach at least 6,500 degrees Fahrenheit. At this temperature all of the constituents of the ore are reduced to the metallic state except the aluminum oxide. Some of the resulting metals are volatilized while the iron and silicon unite to form ferro-silicon, which settles to the bottom of the furnace and is tapped off just after the run is stopped. Fortunately for the success of the process, the aluminum oxide is not reduced by the carbon under the conditions which hold during the furnace run. The process, therefore, assures a product which is free from impurities; but to make assurance doubly sure, the Aloxite is subjected to further refining before it is graded.

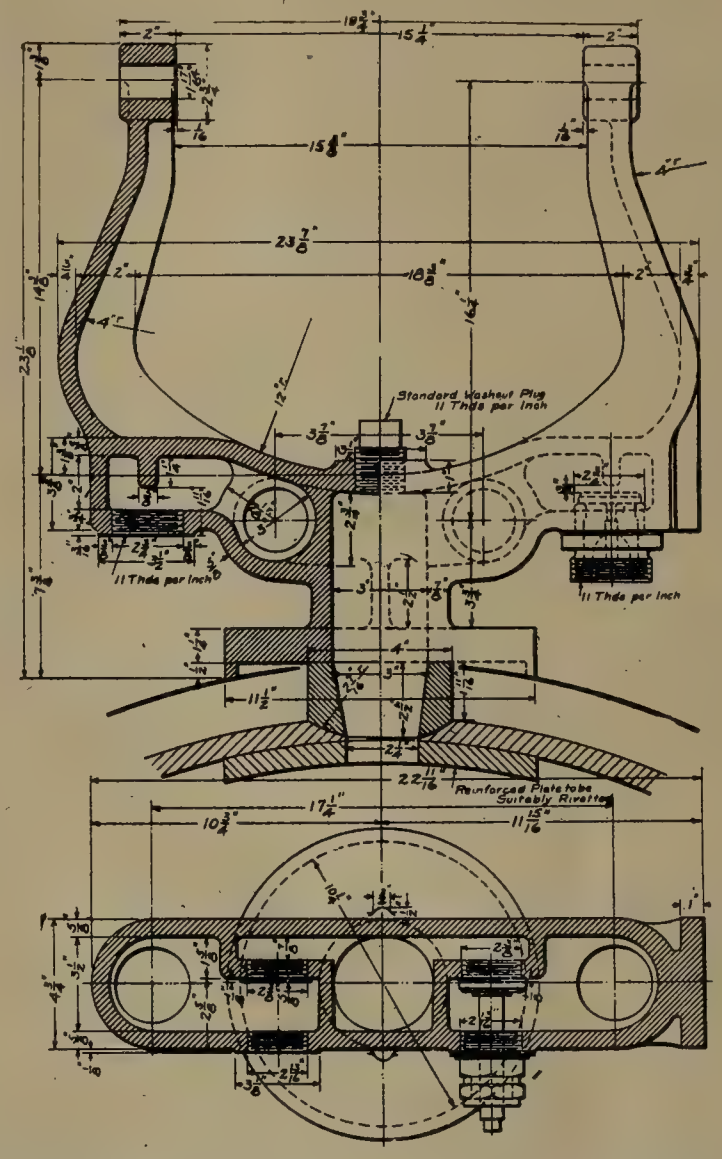
The aluminum oxide as it emerges from its baptism in electrical fire is a product with all its properties raised to a higher power. Its hardness is made harder, its sharpness made sharper, its toughness tougher, and its compactness more compact. It is, moreover, stronger and heavier than the corresponding natural product. The natural product is quite apt to lack uniformity in composition and in structure. On the other hand, the furnace product, which is made by a process under perfect control, is absolutely certain to possess uniformity in both of these properties.

Aloxite, therefore, possesses the qualifications that go to make a good abrasive. It is strong, hard, compact, and tough—fast, clean, and cool-cutting. It breaks with a rough fracture that makes it easy for the bonding material and glue to take hold.

The Intercolonial of Canada, according to reports of the Canadian minister of railways and canals, will purchase 1,432 steel-underframe box cars, 150 wooden box cars, 200 steel-underframe flat cars, 200 steel-underframe stock cars, 100 Hart-Otis coal cars, 35 refrigerator cars, 7 sleeping cars, 4 dining cars, 7 first-class coaches and 3 baggage cars. This road is building some additional equipment in its Moncton shops.

COMBINATION BOILER TOP-FEED CHECK VALVE AND BELL STAND.

The advantages of feeding locomotive boilers at the top instead of the side have been urged for years by many who have found the practice satisfactory. On the Canadian Northern Railway, the top-check valve is double and is combined with the bell stand.



Combination Boiler Top-Feed Check Valve and Bell Stand.

The feed enters the hollow sides of the bell stand through a vertical check valve, passing on through the hollow base into the boiler. Duplicate sets are arranged on each side. An emergency valve is supplied on each side between the main valve and the boiler, both emergency valves being horizontal, alongside of the boiler connection. The bell stand is also provided with a plug in the top for washing out the boiler. It is attached to the boiler top by a flange with a loose ball ring intervening.

This method incidentally does away with the danger of freezing always present with the conventional arrangement in severe weather. With this new arrangement the feed pipe rises on a gentle slope to the bell stand, where there is an outside check valve in addition to the one in the casting.

PHOEBE SNOW DISGUISED.

Two railway officials, one representing the Lackawanna and the other the Lehigh, met in Washington one morning and stopped on a corner to talk. A young negress passed them and spoke to the Lackawanna man.

"Who's your friend?" asked the Lehigh man banteringly.

"Oh," the other answered carelessly, "that's Phoebe Snow. She came up on the Lehigh last night."—*Standard Advertising.*

The Alaska Copper Corporation of Valdez, it is reported, will construct a branch railway from a connection with the Copper River and Northwestern at Strelna to Nugget Creek and the Rairus Mine, Alaska.

The New Era in Machine Tool Design.*

By E. P. Bullard, Jr.

We have been given a new word during recent years and a new profession has been created. We are told that our shops are inefficient; that our methods are out of date; that we make a great many false motions. Our railways have been informed that they lose a million dollars a day by inefficient operation. It is stated that a railway car is in use but two hours out of the twenty-four. This new knowledge is the result of careful analysis, and exact knowledge, so obtained, forms the foundation for the new era.

This means that there is a great demand being placed on the mechanical world at large. All of our industries are being called upon to produce better goods at a lower price and to increase production. We must be more efficient in all our work, as engineers, as shop managers, if we are to succeed. We cannot hope to be paid for inefficiency. The world is going on; it is not standing still, and those of us who are going to uphold the names of our concerns and our individual reputations before the mechanical world, can do it only by keeping pace with the times.

Can you think of a device, a mechanism of any description, which is not affected by the efficiency of machine tools? Everything we have, safety razors, even the capsules in which we take our medicine, are the product, indirectly, of machine tools. We no longer do things in a haphazard way. We have means for measuring accurately and of determining the strength and hardness of materials. A bolt made in the East will fit a nut made in the West. We have come to a state of exact knowledge where we must use that knowledge in the design of our product, so that we may profit by the experience of others, and so that we may have products which will be comparable with products turned out in this country and abroad. We know the strains and stresses of material. We no longer buy our materials by guesswork. We do not place an order for so much steel and let the steel mill send us any kind of steel it has in stock. We specify the percentage of carbon and the chemical analyses of the steel, and we expect it to give certain physical results,—so many thousand pounds tensile strength, a stated elastic limit, a certain percentage of elongation, etc. We have come to the age where we can specify definitely what we want and get it. Standardization has become the watchword. We can specify a certain number of thousandths gauge and get it. A gauge made in one section of the country will fit or check with a similar gauge made in another part of the country. We standardize our operations. We make time studies of operations and benefit thereby. We have gone by the age when it is argued that a time study is of no benefit. We know that we can definitely calculate the time of machining a certain piece. We know also that the time which is definitely calculated in that way may appear to be absolutely impossible of accomplishment. I remember the first automobile flywheel that we produced. Our estimators figured that we could machine one of these flywheels in nineteen minutes. The work came into the shop and the shop superintendent came to me and said: "That is a joke." "What is a joke?" I asked. He replied, "That nineteen minutes. It will take nearer forty-five minutes." However, we found that by following out the time study we obtained our planned result. We have a litter in our files today from the concern that purchased the machines saying that they have averaged a time of seventeen minutes per piece on 14,000 flywheels. I give you this as an illustration of the value of a time study. Without planning the sequence of operations and following the plan we could not have accomplished it. As it was, we averaged seventeen minutes each on 14,000 wheels, showing that many of those wheels must have been made in considerably less time.

We have our instruments of precision. Have any of you ever stopped to think what marvelous things they are? Marvelous in their exactitude—instruments with which we can measure almost anything you can think of, from the hardness of material to the exact size of a particular piece. I sometimes marvel because I know the difficulty of maintaining these standards.

We have a demand, a tremendous demand, an exacting demand, a demand from the masses, for better conditions of living, of travel; they want heat, light, comfort, all the thousands of luxuries which this age has given us, and which now become necessities. Now, how is this demand to be met? We think of it as extravagance, but is it? It is simply the masses living up to the age. There was extravagance in earlier periods than ours. Louis XVI, it is said, spread gold dust on his royal signature instead of blotting it. We have other ways of being extravagant. We want automobiles, we want telephones, we want the thousands of things today which were luxuries at one time, but are now considered as absolute necessities. The luxuries of today are the necessities of tomorrow.

The machine tool must meet this demand. The burden of this demand bears directly on the machine tool, which is the prime factor in the development of civilization. A fanciful thought, I will admit, but it is always the prime factor in meeting this demand; in producing the articles which the world wants. If we are to meet this demand we cannot do it by walking in the footsteps of our fathers. They bought iron and bought steel. They did not specify what their iron was to be, nor did they specify the analysis of the steel. They used other materials, such as bronze, which was yellow, and as long as it was yellow it was good for a bearing. We cannot walk in their footsteps and win. We must utilize the knowledge which is available. We must use the instruments of science and we must profit by the experience of other industries.

Granting that the machine tool is a prime factor in the advancement of our civilization, it seems right and proper that machine tool builders should exercise their energy to make their machines more productive, more useful, if they are to be a real help in the upbuilding of other industries.

How may this object be attained? The answer lies in the one word "Analysis"; analysis of the work to be done, the conditions to be met, and analysis of the means already at hand.

Have designers followed this method? What difference is there between many lathes of today and the lathes of ten years ago? That is the point, gentlemen. There is not the difference between the machine tools of today and the machine tools of ten years ago that there should be. They have not, in all cases, kept up with the times. Many machine tools are, today, identical in detail with the construction of ten years ago. But I tell you that anyone who continues to build a machine of that kind cannot hope, because of its inefficiency, to keep his trade. The machine tool of today must meet the conditions of today.

In analyzing the various elements of machine tools the question naturally arises, wherein can they be improved? First, let us consider the question of control. Control is the essence of machine tool design. It plays the largest part in the production of work. Control is everything. We see it in other products and never think anything about it. When we touch a typewriter key and the letter is impressed on the paper, we think little of that; but there is infinite exactitude in getting that impression. And so with the machine tool. It must not merely be started and stopped; it should be started precisely at the right time, under perfect control, and it should be stopped exactly as you want it and stay stopped until it is again started. The machine tool should do the work, and the operator should use his energy solely in directing it. He should not be called upon to spend his valuable time nor his mental energy in

*Before the Cleveland Engineering Society.

operating an oil can on sixty or a hundred different holes which are supposed to be oiled. He should not be called upon to shift dangerous belts or move heavy parts. There is absolutely no occasion today for an operator to be required to do those things, and any machine which compels the operator to use his physical energy to move heavy parts, to shift belts, or do any of those things which waste time and productive energy, is inefficient in design and construction.

What, then, are the essentials of machine tool design?

1st. The things that we can lay down and say we must have—Productibility. It seems reasonable that we should ask for productibility, the ability to produce. It is of prime importance, for it is what we buy the machine for, and if we cannot get productibility we have not spent our money wisely.

2nd. Durability. Is it unreasonable to suppose that, having paid coin of the realm for a machine, we are not entitled to durability? Productability, of course, is qualified by durability. If it is not a durable machine its ability to produce ceases. So, it is reasonable to ask that a machine be durable, that it will remove the amount of material required in a given time and do it easily and comfortably, and have a sufficient factor of safety in the design of its parts to provide for a continuous performance of the work for which it was installed.

3rd. Adaptability. By adaptability I mean the ability of the machine to meet conditions. Let us assume that we have purchased a machine for a given purpose. The machine should meet these conditions. It is of little interest to us that it may be able to produce work for somebody else; that it may meet Jones' conditions. What we purchased it for was that it should meet our conditions.

We have, then, three essentials in machine tool design: Productaibility, which means the ability to produce; durability, or the ability to stand up and do the work, and adaptability, or the ability to meet our conditions.

Productibility.

There are several factors which enter into the question of productibility, each of which is, in a way, related to the others. If, for any reason, the machine is not in service it is not producing and is, therefore, inefficient.

Continuous operation is an essential factor which is dependent not only on durability but on adaptability as well. If minor details of construction are constantly giving trouble it is not a durable machine, and if long delays are frequently occasioned by the necessity of changing or providing complicated and expensive tool equipments the machine is not adaptable, and the expenditure, therefore, has not been wisely made.

I have already spoken of the starting and stopping, and wish to impress upon you the importance of that detail. I believe the starting and stopping of a machine is, possibly, the most important function of the operating mechanism. The machine should start just when the operator wants it to. It should not start a little ahead of time and take his hands off or his arms off, and it should not lag in starting. The starting and stopping of a machine are two very important factors in its operation. Shifting belts do not meet the new conditions; they are too slow. Efficient clutches are difficult to make.

Power operation of heavy parts is here to stay. It may be inefficient on some machines, it may be inefficient on all, but the time will come when you cannot hire a man to run a machine in your shop unless the machine is equipped with mechanical means for operating the heavy parts. Consequently, it is essential that we should produce machines that are equipped in that way. Incidentally it is just as essential that we should perfect the operation and motion of those parts so that they are under as absolute control as the control of starting and stopping, which I have already stated is very important.

In the matter of the setting of tools, about one-third of the total time paid for is spent in securing sizes. For instance, a machinist is turning a steel casting, and he does not want to spoil it. He has to reduce it to an exact size. He puts it on the machine and spends about fifteen minutes cutting it down a little. After that he tries the calipers on the turned surface and finds that it is about one-eighth of an inch too large. He then starts in and repeats that operation several times. One man out of a thousand can set a machine accurately enough to do this work without wasting time, and the other nine hundred and ninety-nine will do just as this one did. Consequently a machine tool should, to be efficient, take that burden off the man and give him means of obtaining sizes quickly and accurately, and of duplicating sizes every time, so that the mental strain, due to his feeling of responsibility for the casting, is taken off his mind, and he feels free to set the tool in the shortest time and in the most effective manner.

Under productibility comes the question of power. How often do you see a machine that can be loaded up to all the tool steel will stand, and take cuts easily and comfortably and look as if it was going to continue to take them as long as necessary to machine the piece? I suppose there are fity compounds on the market for making belts pull, but let me tell you that a truly efficient machine tool does not need them, for the power will be there in the form of a big belt, a wide belt, and there will be plenty of strength of materials between the belt and the cut to take all that the belt will pull, and the belt should pull more than the cutting steel will stand.

I have seen a comparatively small machine turn off 1,785 pounds of cast iron chips in an hour. The casting was large and the cuts deep, heavy and fast, in fact unnecessarily so, but the machine came through the durability test without difficulty and proved that the design was right.

Power in abundance, excess of power, is an essential part of a producing machine, and it is in this respect that the average machine in the shop is lacking.

Now, as to the correct distribution of metal: Probably every man, when he buys a machine tool, first asks the question, how much does it weigh? Now stop a minute. What does that question amount to? If I, as a machine tool builder, wish to deceive you, I can pour pig iron into the base of my machine and give you weight that costs little and is valueless to you. We can take little, lightly designed machines and fill them up in the bottom and give you weight, but you would not have productibility, because the weight would be in the wrong place.

You will find in the text books, which have been prepared during the past ten years, statements to the effect that machine steel may be turned at the rate of 25 feet per minute, cast iron at 30 feet. I have seen a piece of machine steel, 40 carbon open hearth steel, turned at 425 feet a minute, just like a piece of wood, and turned easily and freely, and that was done because the machine that was doing it could do it easily; it did not vibrate and the cutting tool had an opportunity to work. The cutting tool is a delicate thing, when you think of it. It must have a keen edge to work properly. If it has a dull edge, which it gets very soon after vibration sets in, it ceases to be a cutting tool and becomes a pushing tool, and these ragged, torn chips you see around a shop represent inefficiency, lost power, poor tools and poor machines. The correct distribution of metal is an essential point. I have seen a boring machine take a cut 1⅛ inch wide, $\frac{1}{32}$ inch deep, at 150 feet cutting speed a minute and produce a smooth cut. That was a finishing cut on a cylinder and it was satisfactory. Only the correct distribution of metal can give that result, and that tool could not be made to stand up if the metal in the machine were not there to properly support it and hold its cutting edge right to the work. The correct distribution of metal is one of the very important factors in machine tool design. I believe that machine tools as a rule are light in some of the very essential parts. When we come to have a full understanding of where we should place metal and how we should place it and what kind of metal it should be, we will make a great advance.

There is another point we can make in the cutting of metals, which has to do with the production of work, that seems to me to have infinite possibilities, and that is the use of cutting

lubricants. I had it brought very forcibly to my attention some time ago that there was a large saving to be made in power by the use of cutting lubricants. A machine was in operation in our plant on a steel casting. The foundry, for some reason best known to themselves, had left about three-quarters of an inch on the diameter of the casting, which had to come off. The surface was about sixteen inches wide. The machine was running along very nicely with two large streams of water—I think they figured on about thirty-six quarts a minute—thrown directly on the cuts. There were two cuts, one on the top and one on the side. The chips were turning blue when they came out of the water. I stood watching it and I said to the operator, "Fred, if we turn the water off, what will happen?" He said, "It will burn the tools." "Well, let's shut it off and see," I replied. So we shut down on the water and the machine made one-half of one revolution and the belt went off. We thought we had a broken tool; that a tool had burned. We backed the machine out and the tools were just as they were before. They had not run far enough to be destroyed. So we started the machine with the water and it went along easily and comfortably, and then we cut the water off again. It went less than half a revolution. I tried that enough times to convince me that there was something there I did not understand. I had always thought that lubricant simply made the tools last longer. I did not know that there was any appreciable difference in power consumption, so we brought a motor to the machine and attached a recording watt meter and went at the proposition in such a manner that we could find out what was happening, and after experimenting for several days—which represented all the time we had—we satisfied ourselves that on that heavy cutting there was a difference of 43 per cent in the power required to machine that piece with and without cutting lubricant. As we came down and tried lighter cuts we found, of course, less difference. But there was 43 per cent, gentlemen, on that particular piece, and it is an item, because we have to pay coal bills and we also have to pay for tools that we burn up. Under those conditions it does not pay us to generate too much heat or to keep on generating any unless means are provided to absorb it in a cutting lubricant.

Further experiments along that same line showed us that pieces which we turned without lubricant became so heated that it was not only difficult to handle them, but the dimensions were all out. A hole 15 inches in diameter, when the piece was cold, became 15 inches plus 0.009 inch when a slight racing cut was taken across the top of the casting. Had we taken our measurements of the piece when it was hot they would have been incorrect and we should have had to make allowance for heat, and the allowance for heat is an unknown quantity, depending entirely upon the shape of the piece and the amount of heat which we generate. I believe that not only will we turn all steel with cutting lubricant in the future, but I believe that we will turn cast iron with cutting lubricant. We have tried that in our works and it is not such a foolish thing as you might think. We had some large castings which had to be accurate and which got very warm in roughing out; consequently the error was an unknown quantity. We found that by using cutting lubricant we kept the piece cool and eliminated the possibility of error. Cutting lubricant is a thing you will have to deal with. It will represent an investment which is a wise one and you will find that production will be increased by the investment, particularly when you come to turn alloy steel.

Durability.

We will now take up the question of durability. What are we going to do to make our machines stand up? As we go around our shops we find a machine "down" here and there. Now what are we going to do to make them stand up? We cannot do it by using the carbon steels. Automobiles would not run today, gentlemen, if they depended upon the steel which went into automobiles ten years ago. We must use alloy steel. This is not the age of steel any more; it is the age of alloy steel. We have come to a point where the alloys introduced into steel give qualities which we never dreamed of. You can take a piece of chrome nickel alloy steel and you can form a gear blank of it, and after heat treating it you can hammer one of the teeth over against one of its fellows without breakage. You cannot do that with a piece of cast iron. Look at your physical tests with alloy steel—240,000 to 245,000 lbs. elastic limit, 260,000 to 270,000 lbs. tensile strength. From this grade of steel we can produce a class of goods guaranteed to give certain fixed results. Such steel is not expensive. You cannot measure the value by the pound. Its value is unknown. You can get wonderful results from the use of this material, and when we use this material throughout in machine tools, gentlemen, you will be as independent as the oil trust. You will not even have to go into your shops, because everything will run smoothly. There is no question about the value of this material. I do not want to bore you about it, but I have tremendous respect for the men who have developed it. We have all got to use it.

There is another material that we have today that we did not have ten years ago. We can get beautiful steel castings. We can today get castings made of steel that can run almost as good as gray iron castings, and the steel castings are infinitely stronger, and we can buy them on a chemical and physical analysis. If we want 40 carbon, just tell the foundryman and he can give it to us.

About a year ago I was in a machinery dealer's store looking at a very handsome machine. It was beautifully painted and beautifully polished. Every detail had been taken care of. I noticed a little round disc about as large as a 25 cent piece which said "Oil here." I commenced to look over the machine and I found one hundred and fourteen of them. There were one hundred and fourteen holes on that machine that required attention. A man had to go around every morning with a squirt can and oil those holes. There are one hundred and fourteen chances to one that he will miss one, and it may be the most important one on the whole machine. There is that chance you cannot get away from.

Now, that set me to thinking, and I went home and happened to think of my old automobile. I used to have one years ago and I had to go over it about every twenty miles and take a squirt can of oil and give it to the engine, and it did not make any difference how much I put in the rear axle, it would not stay there anyway. Those were the instructions on that car. I had a later car which pumped oil into the engine; it pumped oil up through the machine and back again, and it certainly struck me as being about the perfection of lubrication. And so, naturally, we went into studying that problem on our machine, and today I am convinced that forced lubrication, not squirt-can lubrication, is one of the elements in machine design which we have to consider. I believe that five years from now all machine tools will be so lubricated. It is obvious we cannot get away from it. There is no amount of criticism that will prevent its being done. The objection which is raised that the oil will get dirty has no foundation. You can filter it if you want to. You can pump it up into your machine, distribute it to the running parts, and you will be surprised, gentlemen, to see the efficiency of the machine so lubricated. I think it is a fair assertion to make that with properly proportioned bearings, so lubricated that the two metals cannot come in contact with each other, the film of oil being mantained by a fresh supply, the life of the machine is prolonged indefinitely.

Another factor in durability is, limited belt speeds. There are limits to everything. Belts are efficient up to a certain point, and when you run them faster than that they cease to be efficient and larger belts are required. Some of you may argue that you do not believe in belts; that you want the machines motor driven. Very well, reasonable speed still holds good. We all prefer moderate speed motors. We do not want our gears running like buzz saws. Gears can run comfortably and easily

and still do their work. This applies just as well to a machine tool as to an automobile.

Another word about excess belt power. You do not want to be right up to your limit in anything. If you erect a building you want to have a factor of safety in that building. Should you not have that same reasonable factor in your belts? A factor which will give your belts longer life and give you larger results. Your belt need not be so tight if it is large enough, and this has its effect on bearings also.

Gears running above 600 feet a minute are liable to be noisy, whereas gears running less than 600 peripheral feet a minute will be quiet. Our text books tell us that gears can be operated 1,200 feet per minute. Our automobile men run them up to 2,000 feet at times, but they have to run on a low gear and run on the maximum engine speed.

Adaptability.

The tool equipment must be universal equipment. We are not considering a special machine purchased for a special purpose. Therefore, the tool equipment should be a universal tool equipment; it should be a standard tool equipment purchased from the maker of the machine. Secondly, ease of setting up. If the total time for doing a piece is an hour and a man has to spend half an hour setting it up there is inefficiency. Now, how to save on that setting-up time; how can it be reduced? By getting machines which, when you turn a lever, will go ahead as you direct. That machine which can be controlled will be adaptable because of the ability to set it up for each job in the shortest possible time; it will be efficient in that respect. And how shall we save time between cuts? What is the use of cuts at high speed, ripping things to pieces, and then losing all we gain because we cannot cut the time between cuts? To cut your costs properly, you must cut the time between cuts. Losing time between cuts is exactly like that idle freight car which they say is in use but two hours out of the twenty-four. This is where you can make big savings in your shop because it is the time lost which you can save by using a machine which is so controlled that the changes of speed, changes of feed and everything required to put the machine into operation, can be performed in the shortest possible time. If you have all these features you will save time between cuts.

General.

Boiling this down, gentlemen, if you can get machine tools in your plants complying with these three essentials which I have given you, you will have machines which will give you maximum production and minimum cost; they will have a maximum life with a minimum maintenance charge; they will be efficient machine tools. And I believe they are coming; I expect to buy them and I expect to make them. I think the concern that does not put heat-treated alloy steel gears into its machines will have to change its methods, or stop; I think the concern that does not adopt forced lubrication will in time have to stop. They will have to change their methods and get into this new line or they will not be in anything. There are machine tool concerns that are complaining of keen competition, and the product they have to sell is not worth buying. It is hard to get the product of the manufacturers who are keeping up to date. People want it; it cannot be had on the market today.

THE FLOOD AT DAYTON, OHIO, seems to have been very considerate of our railway supply friends. We have had reports from a number of them saying that the high waters affected them little or not at all. We are glad to note that the Dayton Mfg. Co. and the Joyce-Cridland Co., both of Dayton, were not touched by the water and are doing business as usual. They report, however, that they are in the midst of a high tide of prosperity.

The Grand Trunk has recently placed orders for 8,000 cars. The Canadian Car & Foundry Co. will build 2,000 box cars; the Western Steel Car & Foundry, 3,000 40-ton box cars and 1,000 50-ton drop bottom special service cars, and the Eastern Car Co. 2,000 box cars.

RECENT SWITCHING LOCOMOTIVES EQUIPPED WITH SUPERHEATERS.

The application of superheaters to a number of switching locomotives recently built marks an interesting step in the development of this class of engine. It is found in practice that the advantages resulting from the use of superheated steam in road service are realized also in switching service. There is considerable economy in fuel and water consumption, and hence with a tender of given size it is not necessary for the superheater locomotive to run to the fuel bin and water tank as often as is the case when using saturated steam. Valuable time is saved in this way. Furthermore, the superheater, by reducing the demands made upon the boiler, is of assistance in suppressing smoke—an important advantage in yard work.

The accompanying illustrations represent two designs of superheater switching locomotives recently built by the Baldwin Locomotive Works. The locomotive for the Chicago & North-Western is one of twenty-nine completed for that road, and five similar locomotives have been built for the Chicago, St. Paul, Minneapolis & Omaha Railway. Fifty locomotives, as illustrated, have been constructed for the Chicago, Burlington & Quincy R. R.

Chicago & North-Western Locomotives.

The locomotives for the Chicago & North-Western are equipped with Schmidt superheaters and exert a tractive force of 23,400 pounds. The boiler has a straight top, with a long firebox placed above the frames. The firebox has corrugated side sheets, and the front end of the crown is supported by four rows of flexible bolts. The furnace equipment includes a steam jet smoke-burner, and also a brick arch supported on two water tubes. With the help of these devices, high volatile coal can be burned with very little smoke. The superheater is composed of sixteen elements and it is of the top-header type with outside steam pipes. The smoke-box is fitted with the Slater front end arrangement, as developed on the North-Western.

The cylinders of these locomotives are lined with steeled cast-iron bushings, 7/8" thick; and the steam distribution is controlled by 11-inch piston valves which are driven by Baker gear. The main frames are of cast steel, with double front rails of forged iron. The driving pedestals are fitted with Markel removable side plates of cold rolled, case-hardened steel, and flangeless shoes and wedges of brass. The driving boxes are also of the Markel design, with removable bearings and side motion plates. These devices have been developed and used with great success on this road.

The principal dimensions are as follows:

Gauge	4' 8½"
Cylinders	18"x24"
Valves	Balanced piston
Boiler.	
Type	Straight
Material	Steel
Diameter	60⅛"
Thickness of sheets	9/16"
Working pressure	180 lbs.
Fuel	Soft coal
Staying	Radial
Fire Box.	
Material	Steel
Length	82"
Width	38⅜"
Depth, front	70"
Depth, back	67"
Thickness of sheets, side	⅜"
Thickness of sheets, back	⅜"
Thickness of sheets, crown	⅜"
Thickness of sheets, tube	½"
Water Space.	
Front	4"

Superheater Switcher for the Chicago & North Western.

Sides	4″
Back	4″
Tubes.	
Material	Steel
Diameter	5½″x2″
Thickness	5½″, No. 9 W. G. 2″, No. 11 W. G.
Number	5½″, 16; 2″, 106
Length	11′ 6″
Heating Surface.	
Fire box	128 sq. ft.
Tubes	897 sq. ft.
Firebrick tubes	12 sq. ft.
Total	1,037 sq. ft.
Grate area	21.8 sq. ft.
Driving Wheels.	
Diameter, outside	51″
Diameter, center	44″
Journals	8″x10″
Wheel Base.	
Driving	11′ 0″
Rigid	11′ 0″
Total engine	11′ 0″
Total engine and tender	41′ 9″
Weight.	
On driving wheel	129,800 lbs.
Total engine	129,800 lbs.
Total engine and tender, about	240,000 lbs.
Tender.	
Wheels, number	8
Wheels, diameter	33″
Journals	5″x9″
Tank capacity	5,500 gals.
Fuel capacity	8 tons
Service	Switching

Chicago, Burlington & Quincy Locomotives.

The locomotive for the Chicago, Burlington & Quincy is one of fifty recently placed in service. The tractive force exerted is 28,300 pounds. The boiler used in this design has a straight top also, but the firebox is wide, and is placed back of the driving wheels. The superheater is of the Emerson type, with eighteen elements. The steam distribution is controlled by 10-inch piston valves, which are driven by the Stephenson link motion, and are set line-and-line in full gear. This is a most satisfactory setting for a locomotive which must frequently start under heavy load.

The principal dimensions are as follows:

Gauge	4′ 8½″
Cylinders	20″x24″
Valves	Balanced piston
Boiler.	
Type	Straight
Material	Steel
Diameter	60″
Thickness of sheets	9/16″
Working pressure	180 lbs.
Fuel	Soft coal
Staying	Radial

Superheater Switcher for the Chicago, Burlington & Quincy.

Fire Box.	
Material	Steel
Length	72"
Width	54¼"
Depth	58½"
Thickness of sheets, side	⅜"
Thickness of sheets, back	⅜"
Thickness of sheets, crown	⅜"
Thickness of sheets, tube	½"
Water Space.	
Front	4½"
Sides	4½"
Back	4½"
Tubes.	
Material	Steel
Diameter	5½" and 2¼"
Thickness	5½", No. 9 W. G.; 2¼", No. 11 W. G.
Number	5½", 18; 2¼", 98
Length	14' 6"
Heating Surface.	
Fire box	105 sq. ft.
Tubes	1,206 sq. ft.
Total	1,311 sq. ft.
Grate area	27.1 sq. ft.
Driving Wheels.	
Diameter, outside	52"
Diameter, center	44"
Journals	9"x10"
Wheel Base.	
Driving	10' 10"
Rigid	10' 10"
Total engine	10' 10"
Total engine and tender	45' 4"
Weight.	
On driving wheels	130,100 lbs.
Total engine	130,100 lbs.
Total engine and tender, about	250,000 lbs.
Tender.	
Wheels, number	8
Wheels, diameter	33"
Journals	5"x9"
Tank capacity	6,000 gals.
Fuel capacity	8 tons
Service	Switching

B. & O. IMPROVEMENTS AT CUMBERLAND, MD.

The Baltimore and Ohio Railroad is completing the enlargement of its terminal facilities at Cumberland, Md., which embraced a general plan of increasing the capacity of the classification yards at that point, the construction of a large roundhouse, machine shop, power house, turntable, cinder pit, etc. Cumberland is one of the most important division points on the Baltimore & Ohio, being situated at the junction of two double-track main lines. The cost of the improvements, including the remodeling of the passenger station, new yard facilities and terminal buildings will be approximately $500,000.

The new roundhouse is of brick construction, with composition roof and asbestos board smoke jack. The roundhouse has 31 stalls, the inner radius being 104 feet and the outer radius 215 feet. There are two drop pits over four stalls, one over two stalls. The building is heated by indirect steam and the boiler washing system has been installed by H. L. Winslow & Co. There is a separate building which contains lockers for the employes and toilet facilities.

The machine shop which is adjacent to the roundhouse, is 142 feet long by 70 feet wide and is also of brick construction. The building is lighted by electricity and the commodious design of the shop enables an abundance of natural light, there being windows on three sides of the building.

The power house is also of brick construction, 67 feet, 3 inches long by 65 feet, 6 inches wide. The building is equipped with 4 Stirling boilers, with a capacity of 250 h. p. each. There is one Laidlaw-Dunn-Gordon air compressor with a capacity of 600 cubic feet.

The turntable has a length of 100 feet and is electrically operated. The lining and drainage of the turntable pit is of brick. The cinder pit is of concrete, and depressed, and the contents will be handled with a crane and clam shell buckets.

The contractors were Westinghouse-Church-Kerr & Co., of New York. The water supply for the terminal buildings will be purchased from the city of Cumberland and ample protection will be provided against fire.

Personals

F. F. Marseilles has been appointed storekeeper of the Atchison, Topeka & Santa Fe at Dodge City, Ia., succeeding C. H. Shuart, transferred to Newton, Kan.

I. L. Hibbard succeeds A. G. Wells as general manager of the Atchison, Topeka & Santa Fe, Coast Lines, with headquarters at Los Angeles, Cal.

D. F. Kirkland has been appointed superintendent of the Birmingham division of the Atlanta, Birmingham & Atlantic vice C. B. Wilburn resigned. His office is at Manchester, Ga.

J. W. Eubank succeeds A. G. Watkins as road foreman of engines of the Chesapeake & Ohio at Cane Fork, W. Va.

D. T. Evans succeeds W. M. Lewis as road foreman of engines of the Chesapeake & Ohio at Covington, Ky.

P. W. Ramer succeeds Andrew Lynch as shop foreman of the Chicago & North-Western at Tracy, Minn.

Howard P. Porter has been appointed superintendent of motive power and equipment of the East Jordan & Southern. His office is at East Jordan, Mich.

W. B. Denham has resigned as general manager of the Georgia & Florida.

H. E. Woodard has been appointed car foreman of the Great Northern at Havre, Mont.

J. E. McLean has been appointed master mechanic of the Kansas City Southern with office at Pittsburg, Kan. He succeeds G. F. Wieseckel.

J. H. Rightmeyer has been appointed superintendent and car accountant of the Kentucky & Indiana Terminal, succeeding T. H. Hayden, resigned. His office is at Louisville, Ky.

Samuel Lenzner has been appointed master car builder of the Michigan Central at Detroit, Mich., vice D. C. Ross.

Jas. P. Carney has been appointed general inspector of the Michigan Central. His office is at Detroit, Mich.

Matthew F. Beagen has been appointed road foreman of engines of the New York Central & Hudson River at West Albany, N. Y. He succeeds W. P. Davis.

F. D. Mahoney has been appointed district foreman of the Oregon Short Line at Montpelier, Idaho. He succeeds J. P. Worthley.

J. W. Small has been appointed superintendent of motive power of the Seaboard Air Line with office at Portsmouth, Va. He succeeds A. J. Poole.

W. M. Ellis succeeds G. R. Brook as foreman car repairs of the Alabama Great Southern. His office is at Birmingham, Ala.

G. H. Church has been appointed superintendent of the Albany Southern with office at Albany, N. Y.

R. A. Bellingham succeeds Carl Hill as master mechanic of the Apalachicola Northern with office at Port St. Joe, Fla.

J. E. Neely succeeds A. L. Stillman as purchasing agent of the Birmingham & Atlantic with office at 25 Broad St., New York.

R. Morgan has been appointed superintendent of the Brinson with office at Savannah, Ga. He succeeds W. D. Cook, who becomes general freight and passenger agent.

F. E. Moore has been appointed superintendent of the Clarendon & Pittsford succeeding C. I. Hunter. His office is at Proctor, Vt.

W. M. Kelsey has been appointed superintendent of the Depue & Northern, succeeding M. F. Chase. His office is at Depue, Ill.

J. A. Read succeeds C. O. Tullock as general foreman locomotive department of the Georgia Southern & Florida with office at Macon, Ga.

C. E. Magee has been appointed master mechanic of the Gulf & Sabine River with office at Fullerton, La. He succeeds C. T. Harrop.

J. J. Rankine has been appointed locomotive foreman of the Inverness Ry. & Coal Co. with office at Inverness, N. S.

John Sutherland has been appointed master mechanic of the Iowa & Illinois at Clinton, Ia., succeeding J. F. Greenleaf.

Evan Jones has been appointed general manager of the Laurel Fork with office at Hampton, Carter Co., Tenn.

E. E. Hanson succeeds J. A. Banks as purchasing agent of the Macon & Birmingham with office at Macon, Ga.

N. B. Scanland succeeds D. Barton as master mechanic of the Maryland & Pennsylvania with office at Baltimore, Md.

H. R. Warnock has been promoted to master mechanic of the Monongahela. His office is at So. Brownsville, Pa.

F. O. Peoples has been appointed master mechanic of the Ohio River & Western with office at Zanesville, O.

J. K. Hitchcock has been appointed general superintendent of the Sunset Railway, succeeding I. L. Hibbard. His office is at Los Angeles, Cal.

P. T. Sanderson has succeeded J. P. Towery as general manager of the Zwolle & Eastern with office at Zwolle, La.

W. J. McLean has been appointed master mechanic of the Kettle Valley with office at Penticton, B. C. He was previously master mechanic of the Duluth, Winnipeg & Pacific at West Duluth, Minn.

J. E. Gardener has been appointed electrical engineer of the Chicago, Burlington & Quincy with office at Chicago.

W. Ross succeeds J. K. Brown as master car builder of the Copper Range with office at Houghton, Mich.

E. Fuller succeeds B. McBride as master mechanic of the Augusta Southern. His office is at Charleston, S. C.

P. J. Clark has been appointed superintendent of motive power of the Georgia, Florida & Alabama with office at Bainbridge, Ga.

J. H. Green has been appointed master mechanic of the Halifax & Southwestern with headquarters at Bridgewater, N. S.

W. H. Cour has been appointed general foreman of the Chicago, Peoria & St. Louis with headquarters at Springfield, Ill.

F. A. Hussey has been appointed road foreman of engines of the Boston division of the Boston & Albany with office at Bacon Park, Mass.

T. L. Carr succeeds E. E. Morris as road foreman of engines of the Pennsylvania Lines West with office at Louisville, Ky.

J. F. Ashworth has been appointed master mechanic of the Tennessee Railway with office at Oneida, Tenn. He succeeds G. E. Whitlock.

R. C. Ross has been appointed acting master mechanic of the Vera Cruz Terminal with office at Vera Cruz, V. C.

H. A. Mills has been appointed road foreman of engines of the Northern Pacific at Duluth, Minn., succeeding A. Mentzer.

M. F. Reagan has been appointed road foreman of engines of the New York Central & Hudson River at West Albany, N. Y.

H. J. White has been appointed general car foreman of the Canadian Northern Quebec, succeeding J. S. Jackson. His office is at Joliette, P. Q.

T. H. McLeod has been appointed master mechanic of the Canadian Northern Ontario, succeeding C. L. Webster, resigned. His office is at Parry Sound, Ont.

L. E. Wingfield succeeds C. A. Leavitt as master mechanic of the Arkansas Central with office at Paris, Ark.

N. B. Scanland succeeds D. Barton as master mechanic of the Maryland & Pennsylvania. His office is at Baltimore, Md.

J. Pollock has been appointed master mechanic of the Jefferson & Northwestern with office at Jefferson, Texas.

J. M. Whalen has been appointed master mechanic of the Valley division of the Missouri Pacific with headquarters at McGehee, Ark. Mr. Whalen served two years on the Missouri Pacific as general foreman at Paragould and Texarkana. Prior to coming to this road, he served three years in the mechanical department of the Rock Island and seven years with the Big Four.

F. C. Hamilton.

F. C. Hamilton, as announced in the April issue, has been appointed general foreman of the Atchison, Topeka & Santa Fe at Argentine, Kan. Mr. Hamilton commenced railway work as a machinist's apprentice at Newton, Kan., in September, 1909. In June, 1910, he was promoted to night roundhouse foreman and in March, 1911, was made day roundhouse foreman, which position he held until his recent appointment.

H. J. White has been appointed general car foreman of the Canadian Northern Quebec and the Quebec & Lake St. John (Quebec Lines). Mr. White is of English and Scotch parentage and was born April 1, 1871, at Brownington, Vt. He commenced railway work May 1, 1893, as joint car inspector at Newport, Vt., for the Canadian Pacific and the Boston and Maine. From September, 1894, to May, 1900, he was joint car inspector for

H. J. White.

the Canadian Pacific and the Canadian Atlantic at St. Polycarpe Junction, afterwards becoming car inspector for the Canadian Pacific at Toronto, where he remained until 1903, when he was transferred to Outremont. In 1906 he was promoted to general car foreman and auxiliary foreman at North

Bay, and in 1911 was transferred to West Toronto, which position he recently resigned to accept his present one.

Charles Boertman has been appointed superintendent of the Pere Marquette shops at Saginaw. He succeeds George Hilferink.

J. W. Brewer has been appointed assistant district superintendent of motive power of the Baltimore & Ohio with office at Baltimore, Md. Mr. Brewer was formerly superintendent of the Mount Clare shops at Baltimore.

P. Coniff has been appointed superintendent of the Mount Clare shop of the Baltimore & Ohio, at Baltimore, Md. He succeeds J. W. Brewer.

T. R. Stewart, master mechanic of the Baltimore & Ohio has been transferred from Baltimore to Cumberland, Md., succeeding P. Coniff.

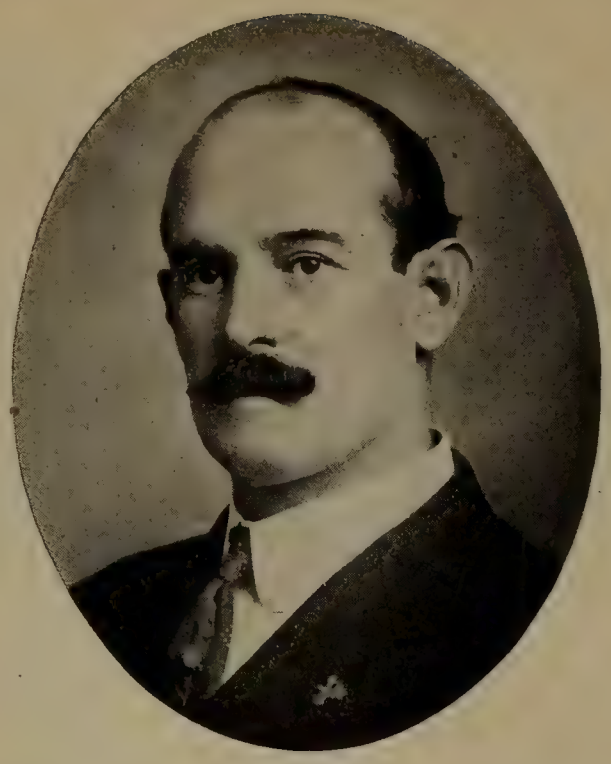
J. Kirkpatrick, master mechanic of the Baltimore & Ohio has been transferred from Newark, O., to the Riverside shops at Baltimore, Md., succeeding T. R. Stewart.

J. F. Bowden, master mechanic of the Baltimore & Ohio has been transferred from Garrett, Ind., to Newark, O., succeeding J. Kirkpatrick.

F. W. Rhuark, master mechanic of the Baltimore & Ohio, has been transferred from Lorain, O., to Garrett, Ind., succeeding J. F. Bowden.

J. A. Anderson has been promoted to master mechanic of the Baltimore & Ohio at Lorain, Ohio, succeeding F. W. Rhuark. Mr. Anderson was formerly general foreman at Lorain.

H. L. McLow, whose appointment as master mechanic of the Missouri, Kansas & Texas and the Texas Central was announced in the April issue, began railway work as office boy in the store department and master mechanics' office of the Chicago & Grand Trunk Ry. at Port Huron, Mich. He afterwards served his time as a machinist's apprentice on the same road, upon the completion of which he worked at the trade on a number of roads. He was foreman of the Missouri, Kansas & Texas at Denison, Texas, for several years, became connected with the National Cotton Seed Oil Co. at the same place for a time, but later returned to the M., K. & T. He resigned from the latter road to accept a position on the El Paso-Northeastern at Alamogordo, N. M., after which he became master mechanic for this road and the Rock Island at Santa Rosa, N. M. From this position he was promoted to assistant superintendent of motive power of the El Paso-Northeastern at Alamogordo, N. M. When this road changed owners in 1904 he returned to the Missouri, Kansas & Texas as foreman of machinery at Greenville, Texas, from which position he was promoted to the present one.



H. L. McLow.

Among The Manufacturers

EFFICIENCY OF CONDENSER AIR PUMPS.

In late years, jet air pumps and rotary air pumps have been introduced for condenser service. The advantages of this type of pump are well known. These are, namely, their simplicity, the practical absence of attendance, and the ease with which repairs can be made by substituting a new outfit for the damaged one.

The introduction was facilitated by the short-comings of the then existing types of reciprocating air pumps. These short-comings consisted in complications such as mechanically operated valves with the necessary valve gearing, large clearance and flash ports, the necessity for close adjustment on account of the small width of the flash ports, their sensitiveness for entrained water and the fact that at high vacuum the heat compression warps the mechanically operated valve, and thereby makes further increase of vacuum impossible. Frequently, these pumps were driven by steam cylinders with complicated Corliss valve gear.

Coupled with these features was the general lack of knowledge of the volumetric efficiency of such pumps. In contradistinction to the ease with which tests can be run on jet and whirling air pumps, tests on reciprocating pumps require more expensive installation and equipment.

The old law that improvement in one line produces improvement in a competing line, is true also in this case, and thus we find a new design of reciprocating pump placed on the market by the Mesta Machine Company of Pittsburgh, Pa.

This air pump which is illustrated by Fig. 1 has no mechanically operated valves on the air cylinder, but has instead automatic valves of the multi-ported plate type (Iversen Patent). There are no flash ports, and no large clearance spaces due to such flash ports. The valves need no attention and no oiling. They open and close at the right time independent of any adjustment.

These valves which have been very successful on blowing engines and air compressors are illustrated in Fig. 2. In order to test this type of pump, for reliability and economy, it was set up in the works of the Mesta Machine Company, and subjected to a thorough test by Prof. W. Trinks of the Carnegie Institute of Technology. The test rigging is shown in Fig. 3. From left to right there will be noticed the bed plate of the air pump, then the steam cylinder and the air cylinder. The large vessel to the right is simply a tank for converting the pulsating suction of the air pump into a steady flow so that the actual quantity of air taken into the pump could be measured by a standard nozzle. This nozzle will be seen at the extreme right of the picture. Another nozzle was provided at the side of the tank away from the spectator and through this nozzle, vapor could be admitted for the purpose of testing the pump under conditions existing in condenser practice. The usual precautions were taken to avoid leakage through the tank and its joints, and to measure the very small amount of leakage which existed when the valves on the tank were closed. The steam passing through the steam cylinder was condensed at atmospheric pressure in a surface condenser located in the pit under the flywheel. The water resulting from condensing the steam was measured in barrels.

In work of this kind, it is not feasible to give the steam consumption per cubic foot of air pumped, because the steam consumption must necessarily vary with the vacuum, with the efficiency of the air pump, and with the efficiency of the prime mover. It is much better to plot the power consump-

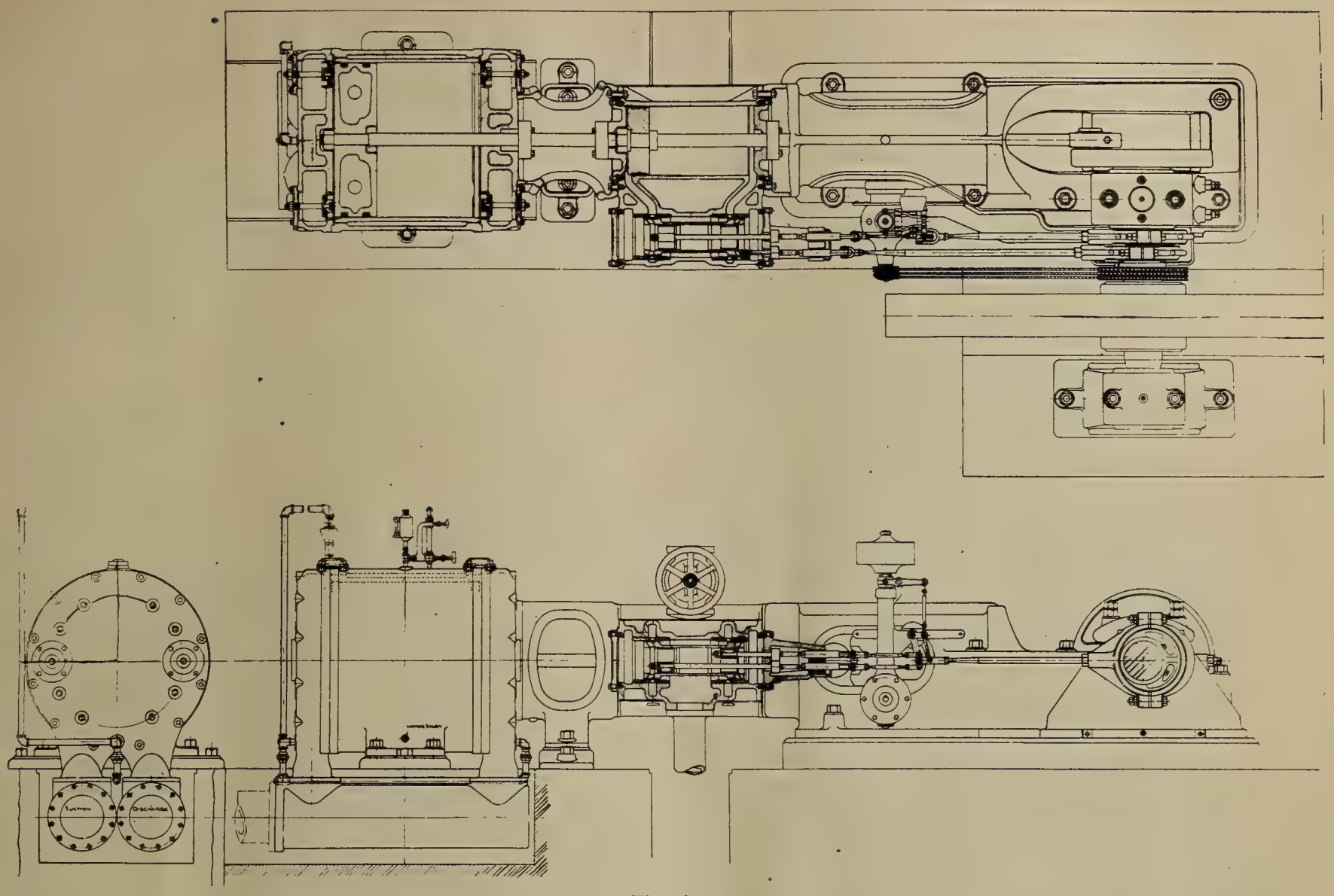


Fig. 1.

tion of the air pump so as to separate the efficiency of the air pump from the efficiency of the prime movers. For this reason, the ratio of the ideal work required for isothermal compression* divided by actual work (including all friction work of engine) required, has been plotted against vacuum referred to 30" barometer; see figure 4. On the same sheet has been plotted the efficiency of the most advanced type of whirling air pump, as taken from tests published in reliable papers, and also the efficiency of whirling air pumps of average type. These latter figures were taken from results furnished by the builders of such air pumps. The illustration shows that for any vacuum less than 29" of mercury, the

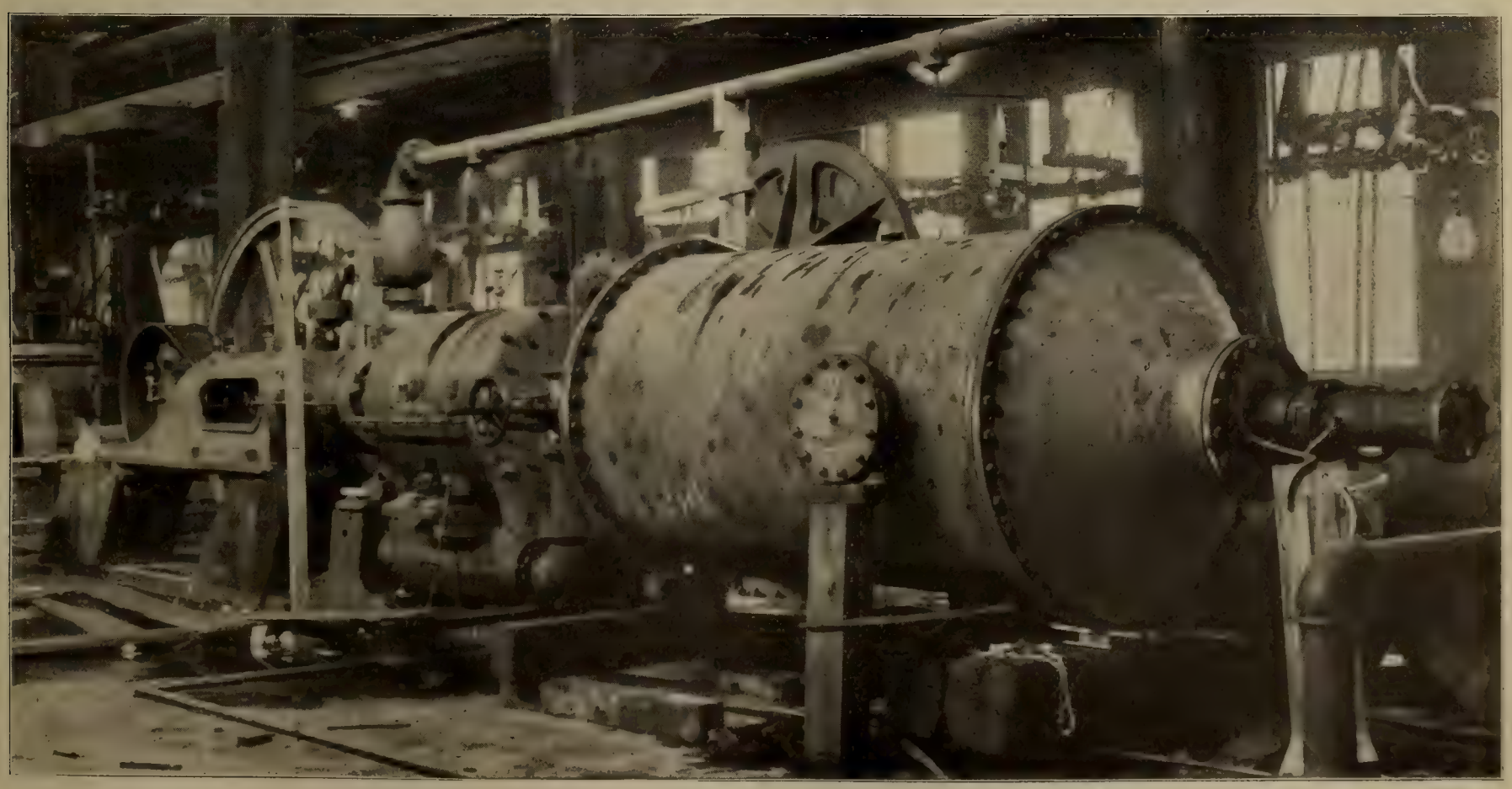


Fig. 3.

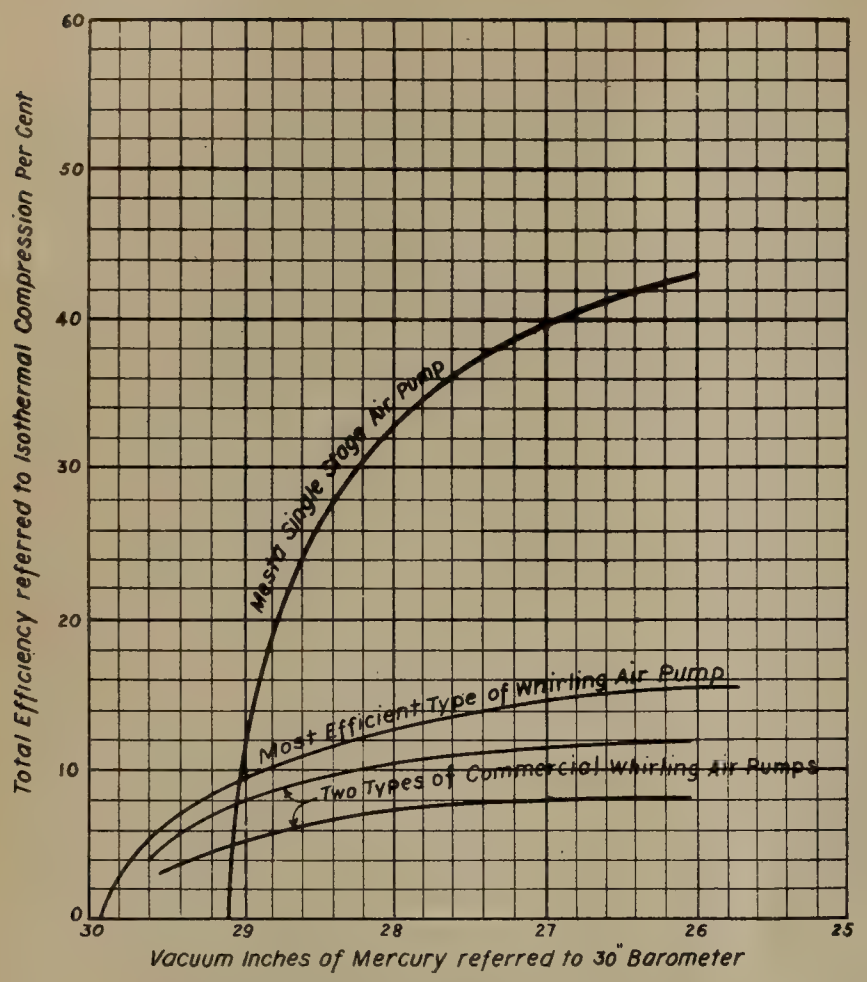


Fig. 4.

single stage reciprocating air pump is superior to the whirling air pump, and that the difference is considerable for any vacuum less than 28½" of mercury. For vacuum above 29", the single stage air pump drops rapidly in efficiency and becomes useless for higher vacuum than 29 1/10. The Mesta Machine Company advises that it is at present building a compound air pump and will furnish test results of that pump in the near future.

The whirling air pumps are commonly driven by small steam turbines whose steam consumption per H. P. hour is of necessity very high. When it is considered that the reciprocating air pump is driven by a fairly economical type of engine (whose steam consumption per H. P. hour is approximately one half of that of the small turbine), the difference in efficiency becomes still more pronounced.

It is not intended to convey the impression that the reciprocating air pump is always superior to the whirling air pump; on the contrary, it will pay in some places to use the whirling air pump in spite of its low efficiency, because exhaust steam is needed to heat the feed water.

On the other hand, the curves on Fig. 4 show conclusively that the reciprocating air pump of the style here described should be used wherever sufficient amount of exhaust steam for feed water heating is available from other sources.

* This method is unassailable. Isothermal compression represents the "rock-bottom-cost" of work for pumping and compressing air. It furnishes a standard method of comparison for efficiencies of air pumps and compressors.

THE HARTMAN CENTER PLATE.

In the April issue of the *Railway Master Mechanic*, on the front cover, appeared the advertisement of the Joliet Railway Supply Company in which the illustration of the Hartman Center Plate was shown in reversed position and did not show clearly the design and construction of this improved type of the Hartman Plate.

Most railroad mechanical men are familiar with the ball type of Hartman center plates, which in their operation not only relieve trucks on curves, but have a centering action to center the trucks after leaving the curves and hold them central on straight track.

This roller type of Hartman center plate overcomes some of the disadvantages found in the ball type and at the same time overcomes the disadvantage heretofore found in coned roller center bearings. Each of the rollers shown rolls in its own independent race-way, each race-way inclined to the center, so that the roller rolls up a slight incline and the weight of the car tends to roll the roller back to a central position which in turn brings the truck back to its normal or central position.

The advantage over the ball type is the greater bearing surface; there being 20 3" face rollers as against 8 2½" balls heretofore used. The rollers are secured in the center plate by small trunnions so that they cannot become lost out as in the case of free balls and the greater bearing surface offered increases the capacity of the plates so that they are now ample for the new types of 70 and 80-ton cars.

It will be noted, by reference to the illustration, that unlike coned roller center plates heretofore made, the rollers in this plate are not placed horizontal, but are pitched centrally. Being placed on an incline in this way, the tendency of the cones to push outwardly is overcome; this pushing effect having caused failures of coned roller bearings with the horibontal rollers.

Heretofore it has been practically impossible to distribute the load over a series of these rollers, with the result that three to four rollers usually carry the load, due to variation in

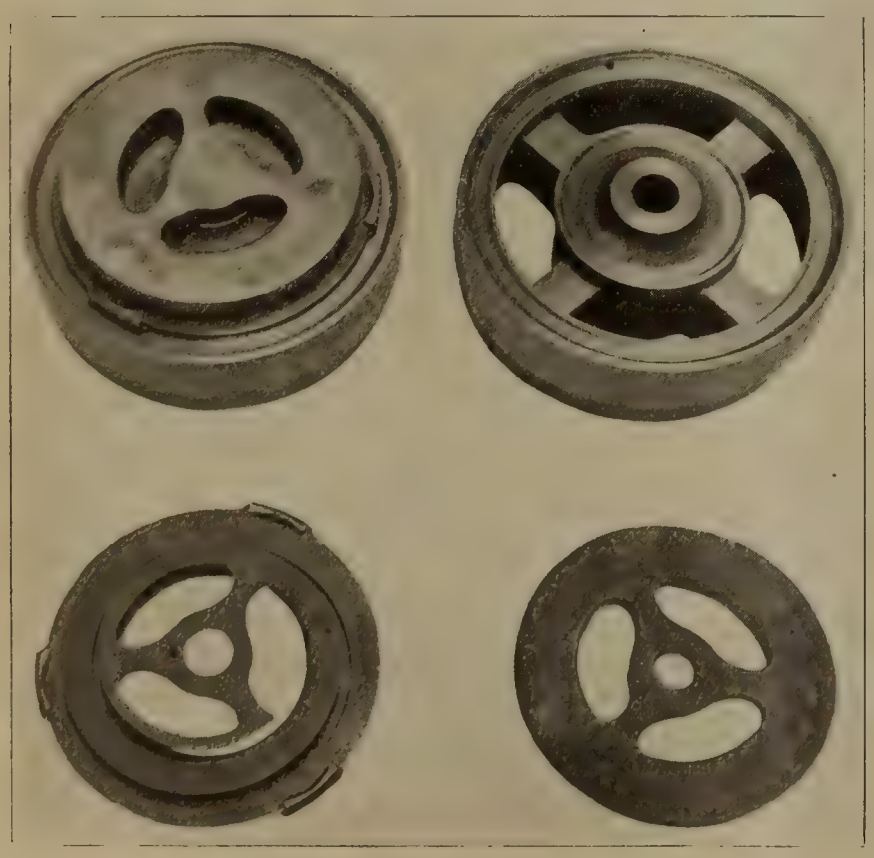


Fig. 2.

Hartman Roller Center Plate.

diameter of rollers and inequalities of plates. In this method of construction, the tendency of the rollers under load are to work slightly outwardly, but without the great force as heretofore. The rollers, therefore, of the larger diameter work to the outer circumference of the center plate, when the rollers of the smaller diameter, if any inequalities, work downwardly until they come into contact with the wearing plates and until they take their share of the load, thus distributing the load nearly equally over all of the rollers which has been accomplished in no other type of center plate.

While the ball type of plates have been found of sufficient durability for up to 50-ton cars, these new plates are of ample capacity for the heavier equipment.

RENEWABLE FUSES.

The cartridge fuse in some classes of electric construction has been considered the standard means for protection against excessive current. These fuses have been considered by the manufacturers to be non-refillable. A dangerous practice has, however, developed as a result of the discovery that such fuses can be refilled and thus used over again several times. In spite of the warning of manufacturers that refilling can be done only at risk of losing fuse protection this practice has continued.

The Economy Fuse & Mfg. Co., Chicago, has found in this situation a demand for a refillable fuse. This concern has developed a cartridge fuse adapted to refilling with previously tested renewal links furnished at a small cost.

In the ferrule type, a fuse link is inserted in the fiber shell, one end being bent over a slotted washer placed over the end of the fiber shell. A cap is screwed on the fiber shell at this end clamping the fuse link in position and providing electrical contact between the inner surface of the cap and the fuse link. The fiber shell is then filled with powdered filling material and a slotted washer is placed over the open end. The exposed end of the fuse link is then bent over the washer and the cap screwed on, thus completing the electrical circuit. The cap is provided with a tapered opening which exposes the fuse link and the rating at all times, making it impossible to defeat the object of the device by inserting a fuse element of improper metal, without detection.

In the knife blade type a radically different construction is employed to obtain the essential requirements of this type of fuse, namely: absolute parallel alignment of the copper blades, slight flexibility of blade position, perfect contact between blades and fuse element and general substantial mechanical construction which will withstand the hardest service without appreciable deterioration or wear.

The first two requirements are obtained by a simple and unique construction consisting of two slotted washers which slide into position through and around the copper blades from opposite sides, the inner washer having a flange on its under side which co-operates with notches milled in the end of the fiber shell to prevent rotary movement of the blades.

Contact between the blades and fuse element is obtained without the use of solder by a heavy iron machine screw construction which, combined with ample contact surfaces, insures a good contact and at the same time permits of very easy renewal.

After the washers are positioned on one of the blades members, a small quantity of shredded filler is placed around the narrow portion of the blade immediately under the washers. The entire assembly is passed through the fiber shell and a shouldered cap is screwed on the fiber shell to hold link and blade assembly in position.

The shell is then filled with powdered filler and a small quantity of shredded filler is again applied, and the washers and cap placed in position as in the assembly of the first end.

This construction permits of a slight flexibility which insures good contact without respect to the alignment of the clips into which the fuse is inserted, and eliminates heating in fuse terminals that is the cause of unnecessary burn-outs.

Venting of the Knife Blade Type Fuse is obtained through the openings in the slotted washers, which, in combination with the clearance provided between the various members, form an unobstructed circular and angular path to the open air.

WOOD WORKING MACHINERY.

One of the industries that has grown by leaps and bounds, thus typifying Chicago's remarkable industrial development, and which is deserving of consideration by the railroads, is the Chicago Woodworking Machinery Co., 162 N. Clinton St., Chicago. Organized in 1907 in the flush of the panic, it grew rapidly in spite of unfavorable business conditions, until in 1911 it was found necessary to increase its capitalization to take care of its ever increasing business. This growth has been greatly augmented under the change of management which took place in August, 1912. Warehouses have been established at Ft. Wayne, Indianapolis and Malden, Mo., and in addition to greatly increasing their floor space in Chicago, a knife and saw department has recently been added.

H. H. Hanna, Mgr. & Treas., Chicago Woodworking Machinery Co.

In the stock carried by this company representing an investment of over $250,000.00 can be found both new and rebuilt equipment of every description, it being possible to fully equip a shop from it. Not alone woodworking machinery, but drill presses, planers and other equipment for machine shops will be found here, including the lines manufactured by the Sterling Machine Co., Fox Machine Co., Silver Mfg. Co., Sidney Tool Co., Forest City Bit & Tool Co., Jones Superior Machine Co., Phillips Mfg. Co., H. B. Smith Machine Co., P. Pryibel, Hanna Breckenridge Co., Indiana Machine Works, Knight Mfg. Co., Hydraulic Press Mfg. Co., Buss Machine Works, American Saw Mill Machinery Co., Advance Machinery Co., and many others.

Much of this assortment is rebuilt, practically as good as new, and can be bought at a big discount. This company specializes in fitting out shops complete.

New Literature

The Gold Car Heating & Lighting Co. of New York has issued a folder entitled "Fresh Air Supply without Draughts," which deals with the Gold curtain window ventilator. This is a device applicable to office and house windows.

* * *

Bulletin No. 18 of The Francke Co., of New York, describes the Francke flexible coupling for direct connecting steam and gas engines, dynamos, motors, shafting, etc. It is made in sizes suitable for ¼-inch shafts and up. It is all steel, being composed of a large number of spring leaves, is flexible in

every direction and is indestructible. Smith-Serrell Co., Inc., of New York, are the general sales agents.

* * *

The April issue of The Little Blue Flag, published by Lowe Brothers Co., Dayton, O., manufacturers of paints and varnishes, contains a flood supplement showing a large number of interesting views of the recent flood at Dayton.

* * *

The Safety Heating & Lighting News, published by the Safety Car Heating & Lighting Co., of New York, contains an article in its April issue on the report of postal car illumination tests, conducted by the electrical department of the Baltimore & Ohio.

* * *

"Cleaning Locomotive Arch Tubes" is the title of a pamphlet recently issued by the Lagonda Mfg. Co., of Springfield, Ohio. The pamphlet points out how, due to the fact that the tubes now used by many large railways for supporting arches in the fire box are subjected to enormously high temperatures and the rate of water evaporation in them is high, scale deposits form quickly and cause damage. The pamphlet then describes a special type of tube cleaner manufactured by the Lagonda Mfg. Co., for use in locomotive arch tubes.

* * *

The Joseph Dixon Crucible Co., of Jersey City, N. J., has just published a new booklet entitled "Graphite for the Boiler." This booklet deals with no new discovery, for graphite has been sold to remove scale from boilers for many years. It simply states in as few words as possible why and how Dixon's boiler graphite does its work. No startling claims are made, for the subject is too old to longer be sensational.

* * *

The Walker & Bennett Mfg. Co., of New York has issued an attractive catalogue entitled "Fashions in Car Seats," which contains illustrations of all the standard types of car seats. Something new in car seat construction is shown in style number 400; a sanitary hinged car seat. This is hinged on the pedestal and can be tilted over towards the aisle quickly and easily for cleaning, painting and repairing the car. There are no castings; the wall bracket and pedestal are of pressed steel and the rods are of tubular construction.

* * *

H. B. Underwood & Co., of Philadelphia, Pa., have published a catalogue of eighty-four pages, which reflects a great deal of credit on the firm and the printers. It is 6 x 9 inches in size, is bound in heavy flexible cardboard and the printing is on a yellow tint background. A full line of portable tools for railway repair and machine shops is described and illustrated. Among these are included portable boring bars, cutter heads, facing arms, valve seat planers, rotary flue cleaners, crank pin turning machines, radius planing attachments, portable milling machines and pipe benders.

Industrial Notes

Francis T. West, northwestern sales agent for the American Iron & Steel Manufacturing Co., has removed his office from The Rookery, to 1547 McCormick building, 332 South Michigan avenue, Chicago.

The Chicago Railroad Construction Co. has been incorporated with a capital stock of $100,000 and proposed to engage in general contracting and railroad concstruction.

E. R. Schoenberger, formerly connected with the Griffin Wheel Co., Chicago, Ill., has been made manager of the western railroad department of the U. S. Metal & Manufacturing Co., New York, with office in Chicago.

The Franklin Mfg. Co. has moved its New York office from 50 Church street to 17 Battery Place.

C. Wadsworth has established an office at 961-3 Woodward avenue, Detroit, Mich., as manufacturers' agent for the purpose of representing manufacturers of contractive machinery and materials of construction, making more or less of a specialty of municipal equipment and supplies.

W. C. Andrews has become affiliated with the Edison Storage Battery Co., Orange, N. J.

Raymond J. O'Brien has resigned his position in the railway engineering department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., to accept a position with Gibbs & Hill, consulting engineers.

The Grip Nut Co. has moved its Chicago office from the Old Colony building to 661-663 McCormick building.

A. Eugene Michel and staff, advertising engineers, New York, have removed from 21 Park Row into larger offices, Rooms 1001-7 Woolworth building.

The National Railway Equipment Co., Chicago, Ill., has moved its offices from the McCormick building to 661 People's Gas Building.

The Titanium Alloy Manufacturing Co. announces that the sale of its products will hereafter be in charge of the general manager, Andrew Thompson, with offices at Niagara Falls, N. Y., and that A. C. Hawley will represent the company in the Pittsburgh district, being located at the company's office, in the Oliver building, Pittsburgh.

The Union Spring & Manufacturing Co., Pittsburgh, Pa., has moved its New York office from 149 Broadway to 50 Church street.

Westinghouse, Church, Kerr & Co., New York, has moved its general offices from 10 Bridge street to 37 Wall street.

The name of the Bettendorf Axle Co., Bettendorf, Ia., has been changed to The Bettendorf Co.

The Davis-Bournonville Co., manufacturers of oxy-acetylene welding and cutting apparatus, with general offices for the past 6 years in the West Street building, New York, have removed their New York city office to the Hudson Terminal building, 30 Church street. The Chicago sales office of the company has been moved from 515 Lafin street to 202 Monadnock building. At the recent annual meeting of the company, the following officers were re-elected: Augustine Davis, president; Harold Rowntree, vice-president; C. B. Wortham, secretary and treasurer.

The Dearborn Chemical Co., Chicago, is building a reinforced concrete manufacturing plant at Toronto, Ont., at a cost of about $100,000. This plant, which will be completed during the coming summer, will have railway connection with both the Canadian Pacific and the Grand Trunk. A. W. Crouch will have charge as vice-president and general manager, with office in Toronto. Mr. Crouch has for the past eight years been district manager of the company, with office in Pittsburgh, Pa.

The Gould Coupler Co. has moved its New York offices from 341-347 Fifth avenue to 30 East Forty-second street.

The Western Railway & Mill Supply Company, San Francisco, Cal., which makes and sells railway supplies, has changed its name to the Edward S. Sullivan Co.

The Yale & Towne Manufacturing Co., New York, has moved its general offices from 9 Murray street to 9 East Fortieth street, New York. The new building, built and owned by the company, is twelve stories high and occupies a plot 50 feet by 100 feet. The entire ground floor will be devoted to exhibit rooms.

One of the recent recruits to the army of railway supply men is J. L. Ponic, with offices at 1200 Karpen Bldg., Chicago, who has severed his connection with J. B. Clow & Son, after twelve years service and taken over the representation of the Illinois Car and Mfg. Co., in combination with the Rhode Island brass seat union. Mr. Ponic will be quickly recognized by the railway fraternity

J. L. Ponic.

as the moving spirit in the several entertainments given at the Storekeepers conventions and the annual banquets of the Western Railway Club, his impersonation of the "German Senator" always proving one of the bon mots of these very enjoyable shows. To quote a characteristic witticism of the subject—"any one who does not yet know me in the railway field can quickly get acquainted by sending me a bona fide requisition."

John T. McGrath, who until recently was superintendent of rolling stock of the Chicago & Alton, has engaged in the manufacturing business as the head of a new company, McGrath & Son, which he has organized at Bloomington, Ill., to build the well known "McGrath" boiler and forge shop appliances.

Mr. McGrath started railway work as an apprentice at the age of thirteen in the Toronto shops of the Grand Trunk Ry. He progressed through the course and in 1897 was appointed general foreman of the Stratford shops. His ability being quickly recognized, he was the following year appointed master mechanic with headquarters at Port Huron, Mich. After seven years at Port Huron the company intrusted Mr. McGrath with the designing and planning of the new Battle Creek shops. These shops have since proven from an operating viewpoint to be among the best in the country. He was placed in charge of the shops upon completion and built up around him a most efficient organization, which he successfully directed until offered the position of superintendent of rolling stock of the Chicago & Alton R. R., which he accepted in the latter part of 1910. This position he filled with his usual success until the change in executive management in the fall of 1912, when he resigned for the purpose of manufacturing the machinery which he had invented and developed during his years of shop direction.

This machinery has become well established through Jos. T. Ryerson & Son, which concern still has charge of the sales. The devices include a complete flue repair equipment consisting of safe end welders, cutting machines, pneumatic welders, expanders, hot saws, etc., and also a very practical pneumatic turntable motor.

Mr. McGrath's pleasing personality has won for him a host of friends and his business success would seem assured.

J. T. McGrath.

C. A. Seley has resigned as mechanical engineer of the Rock Island Lines, effective May 1, to engage in a manufacturing business, the details of which will be announced later. He thus ends a railway service of approximately twenty-five years. Mr. Seley was born December 26, 1856, at Wapella, Ill., and began railway work in 1879 as a draftsman for the St. Paul, Minneapolis & Manitoba. From 1881 to December, 1886, he was engaged in other work of a mechanical engineering nature, and then until January, 1888, was chief draftsman for the St. Paul & Duluth. The following four years he was with the Great Northern, and in May, 1892, he entered the railway supply business, returning to active railway service in March, 1895, as chief draftsman for the Chicago Great Western. He left the latter road in April, 1899, to become mechanical engineer of the Norfolk & Western, which position he held until May, 1902, when he was appointed mechanical engineer of the Rock Island Lines, with headquarters at Chicago. Mr. Seley has been an active member of various railway associations in committee work, and has served as a member of the executive committee of both the Master Car Builders' and Master Mechanics' Associations for many years. For three years prior to January 1 last he was a member of the sub-committee of mechanical officers of the Special Committee on Relations of Railway Operation to Legislation, which conducted the negotiations between the railways and the Interstate Commerce Commission and the postoffice department on safety appliances, boiler inspection rules and steel postal car specifications. He acted as chairman of this subcommittee most of the time. Mr. Seley was president of the Western Railway Club in 1907 and 1908, and has been chairman of various committees. He is also author of many papers on railway electrification and on car, locomotive and boiler design.

C. A. Seley.

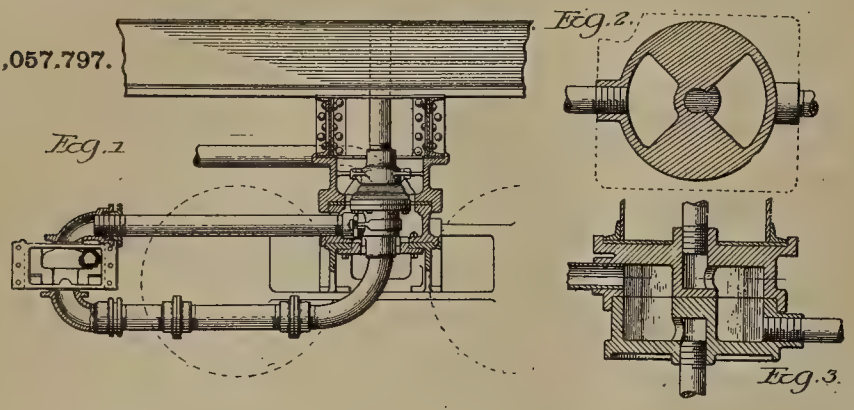
Recent Railway Mechanical Patents

ARTICULATED LOCOMOTIVE.

1,057,797—Lorin W. Barger, Davenport, Iowa, Assignor to Davenport Locomotive Works, Davenport, Iowa.

This invention has for its object the transmission of the live and exhaust steam from the superstructure of the locomotive to the trucks and vice versa, in such manner that the turning of the trucks within the arc described by the curves of the track does not interfere with the passage of the same. This is accomplished by the comparatively simple means shown in the illustration.

1,057.797.



In Figs. 2 and 3 of the drawings is shown a modified construction of means for permitting this simultaneous passing of the live and exhaust steam through the pivotal connections of the car trucks with the superstructure of the locomotives. This modification comprises structural changes in the center-bearing castings of the locomotive under-frame, and trucks therefor, that dispense with the necessity for a pipe coupling.

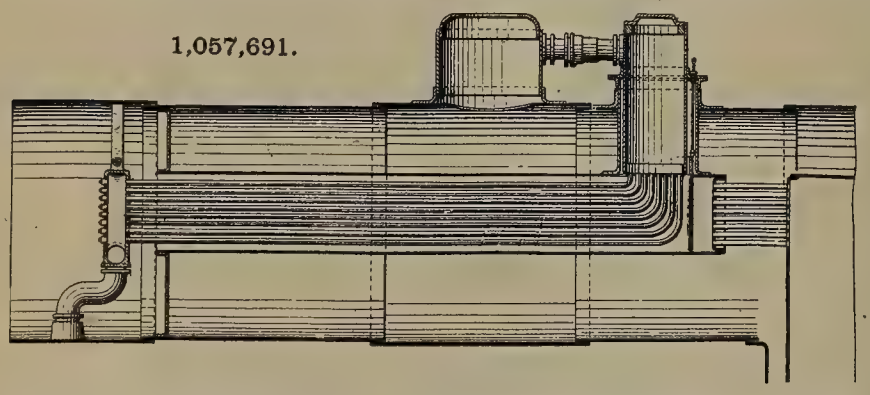
SUPERHEATER.

1,057,691—Jacques L. Vauclain, of Philadelphia, Assignor to Locomotive Superheater Company.

This relates to superheaters for locomotive and like boilers in which the superheater pipes are located in a group in a large fire-tube or flue on the boiler.

The object is to to facilitate the insertion and removal of the individual superheater pipes and in accordance with the invention the steam from the boiler is delivered to a steam dome, which is preferably auxiliary to the main dome and has in its bottom a tube sheet in which the ends of the superheater pipes, turned up at substantially a right angle to their length, are suitably secured. The pipes extend

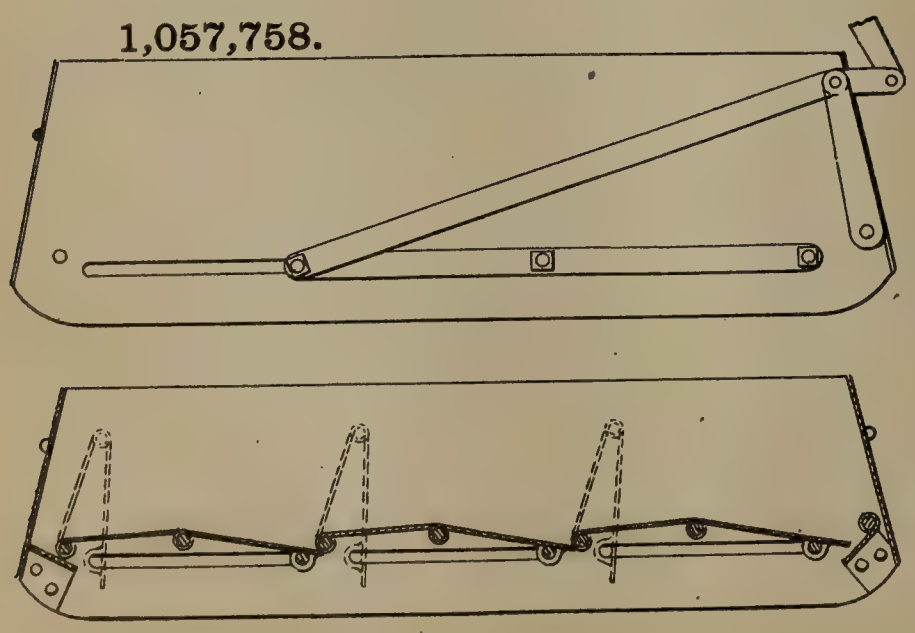
1,057,691.



forwardly through the flue into the smoke-box, where they are secured in the usual manner in vertical headers separated in vertical planes so as to permit the bent pipes to be introduced between them from the forward end and secured in the headers.

The flow of the steam, it will be observed, is unidirectional. If desired, a damper may be located within the flue and provided with a rod by which it may be raised or lowered and supported in an adjusted position.

1,057,758.



ASH-PAN FOR LOCOMOTIVES.

1,057,758—Charles C. Mattox, Laurelville, Ohio.

The bottom of the ash-pan consists of a series of folding leaves, composed of two plates hinged together. One edge of each plate is adapted to rotate on a transverse rod which extends through and is secured in the plates. The free edge of each plate is mounted on a transverse rod, which extends through slots in the side plates and into connecting bars.

On each side of the ash-pan suitable connections are made from the bars to the rock arms mounted on a rock shaft. The rock arm on the left, or fireman's side of the locomotive, is connected to the lower end of a hand lever, which extends upward into the cab and is fulcrumed to a suitable part of the locomotive framework.

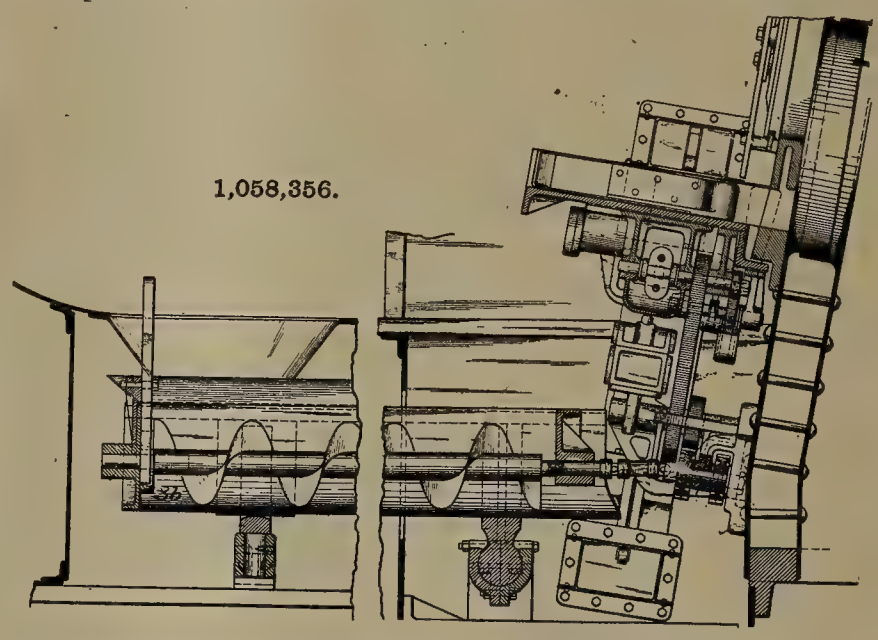
When the lever is pulled back the rods connected by the bars will simultaneously slide forward in the slots, so that the leaves will assume the position shown by the dotted lines.

MECHANICAL STOKER.

1,058,356—Albert G. Elvin, Somerville, N. J.

This stoker is of the over-head and so-called "scatter" type, in which the fuel is mechanically projected into the furnace, above its grate, and distributed over the surface thereof, through the momentum imparted to successively supplied quantities of fuel by the movements of power actuated members with which they are brought into contact. The object is to closely approximate the results, as to proper distribution of the fuel over the entire area of the grate, of the manual labor of a competent fireman.

1,058,356.



A fluid pressure motor is provided, which actuates the following: A conveyor by which fuel is transferred from the coal bin of the tender to the vicinity of the firebox of the locomotive; an elevator to which fuel is delivered by the conveyer and by which it is raised to the proper level for firing; a shovel box or receptacle to which fuel is delivered by the elevator; a swinging shovel by which fuel is carried from a location of deposit in the shovel box and projected into the firebox, and an intermediate mechanism through which said shovel is actuated by the motor.

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(Signed)
WILLIAM E. MAGRAW, PRESIDENT.

Sworn to and subscribed before me this 28th day of March, 1913.
(Signed) Robert R. Grieg,
(My commission expires Oct. 26, 1915.) Notary Public.

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Published at the World's Greatest Railway Center
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An Economic Waste of Capital.

In many parts of our country interurban railways of high and low grade construction are paralleling steam roads for great distances in the aggregate. Owing to the low cost of operation and the small investment of capital, low rates of fare and frequency of service attract the local traffic from the older steam roads. Where additional traffic is created or congestion is relieved by the advent of the interurban, the public is no doubt greatly benefited; but, as is more often the case, when the electric line simply takes over the local traffic of the steam road, and when no new territory is developed, an analysis of the situation can show nothing of material benefit to the public and therefore there is a great economic waste, which means nothing more or less than an additional burden upon the public.

The electric road attracts the traffic by frequent train service and a greater number of local stops. Meanwhile the large investment represented in the steam railway line, which it parallels, lies idle.

The investment necessary to give excellent and frequent local service on the high grade steam branch line is measured by the cost of storage battery, gasoline or steam motor cars for operation in individual units. The track is there, the station and terminal facilities are there, the organization is there. How simple it would be to supply better service than that furnished by the paralleling interurban at a cost so low as to make the interurban an impossibility.

It should be possible to operate these single, self-contained power plant cars with profit and still equal the lowest rates of fare which would make the interurban profitable.

The class of business in question is one which legitimately belongs to the steam road and it is a class of business which can be handled efficiently, economically and in all ways satisfactorily by the steam road organization on the steam road's tracks with but very little outlay for equipment in rolling stock.

Railway managements cannot continue to neglect this class of traffic where it can be handled in such a way as to work it in without embarrassment or difficulty in handling through business. It then becomes a question of the type of passenger carrying unit best adapted. Representatives of each class mentioned are in service and careful investigation will develop the unit best suited for the service requirements.

Coaling Stations.

A great deal has been said and done within the last half dozen years on the subject of locomotive fuel consumption. The education of engine men in the proper handling of their engines, the application of devices to increase locomotive efficiency, the prevention of coal losses from tenders, and numerous other methods have been taken up in order to cut down the fuel consumption. Closely identified with this work has been the Traveling Engineers' Association. Its work and its efforts have placed its members on a higher plane and made them a factor in fuel economy on American railways.

However, fuel economy means keeping a careful eye on the fuel from the moment it becomes the property of the railway company. There is one step in its journey from mine to firebox

which does not seem to have received much attention from those interested in economy of fuel, however. On another page we publish an article on "The Coal Pile," by J. S. Sheafe, in which he makes some interesting comments as to the effect of the coaling station on fuel economy. As he says, coal should reach the tender just as it leaves the car, with the exception that the large lumps are broken. However, the coal does not reach the tender in this condition, and there is much unevenness in the manner in which the slack is distributed throughout the body of the coal. An uneven distribution of this slack coal is sure to decrease the efficiency of the fuel.

Our railways have given comparatively little thought to the subject of the coaling station, yet this is really the link between the locomotive and the mine. It should do its part efficiently. Mr. Sheafe recommends the breaking of coal by breaker bars, as tending to decrease the amount of slack produced. He also recommends care in determining the floor slopes, and making the dropping of the trough one operation and the opening of the slide another. The latter, he claims, would compel the coal to be taken from the chute directly as it comes. He advocates a floor slope of from 55 to 60 degrees as the one which will give the most satisfaction.

There is opportunity for thought on Mr. Sheafe's comments. This slack coal can be burned with efficiency if it is fairly proportioned with the remainder of the coal, but when a number of engines receive their tenders nearly full of slack, it cannot be expected that they will show a high record in efficiency. The design and operation of the coaling station does have an effect on locomotive efficiency. Then is it not time that it should receive more consideration?

Railway Repair Shops.

Realizing the wide differences of opinion among railway officers and others responsible for many of the recent installations of all types of railway repair shops, we requested several well known persons of wide experience to write us their opinions on the subject. On another page of this issue we publish these opinions. We believe that the articles are of the greatest importance in view of the prestige of their authors and that those contemplating the construction of additional repair facilities will profit by careful study of the opinions expressed.

The construction of a modern repair shop often involves appropriations running into the millions of dollars and the most thorough and careful consideration is expected of those who would decide the type of erecting shop, as upon the arrangement of the tracks, pits and machinery of this department, the complete layout depends.

Mr. Gaines goes into the subject very thoroughly and he can point with pride to Macon where his principles have been carried out with gratifying success. Nevertheless there are those who do not agree with him that the transverse shop best fits his requirements or those of others. Mr. Caracristi, who is more or less responsible for a most interesting design exemplified at Brewster, Ohio, and Watervliet, N. Y., defends his ideas briefly and pointedly and the operation of the two shops since their completion seems to have been so satisfactory as to wholly verify his arguments.

Considering only the two conventional designs, Mr. Enright tersely and pointedly states that there is a distinct advantage of one over the other depending upon the class of power to be repaired. He recommends the transverse shop for light locomotives and the longitudinal shop for heavy power. This distinction does not seem to have been made by others and it is possible that his position will not be considered well taken, at least not without further argument.

An interesting defense of the frequently criticized "herringbone" shop is contained in the article written by Mr. Goodwin. His description of the methods peculiar to the type is interesting and will offset much of the adverse criticism noted. The obviation of the transfer table without making it necessary to lift engines by means of cranes over the other power undergoing repairs is the principal feature of the type.

Probably no higher authority than Mr. Battey of the Arnold Co. ever expressed his views on this subject publicly. Mr. Battey is responsible for the satisfactory service of a great many of the shops of both the United States and Canada. His experience warrants reliance upon his opinions in repair shop design. This publication is fortunate in being able to publish his views as expressed on another page.

It is true that any one of the types mentioned if modernly equipped and arranged can be made to operate with satisfaction and for this reason much depends upon the planning of the facilities subsidiary to the main erecting shop. Moreover, the most ardent supporter of a certain type may find it necessary to adopt another scheme when his own turn comes and he has sized up the limitations of location.

Safety Men.

The Central Safety Committee of the Chicago & North Western has issued a report covering the work accomplished during the years 1911 and 1912 by the safety organization of this road. The report is signed by Ralph C. Richards, chairman of the Central Safety Committee. Among other things the report says: "What is needed is more Safety Men as well as Safety Things." It is a comparatively easy matter to devise safeguards and safety appliances, once we set ourselves to the task. Almost every machine can be so guarded that the risk is minimized or eliminated. But creating Safety Men is a much more difficult matter and it is by far the most important, for when we have created Safety Men we will have automatically provided for Safety Things.

The success of the "Safety First" movement on the North Western has been due to the fact that the men back of it realized that it depended on creating "Safety Men"—men who would think not only of themselves but of their fellow-workers. The report shows that of the total number of recommendations made by the various divisions and shops on which action was taken during 1912, 4,382 were adopted and 163 rejected. The number of the suggestions is indicative of the number of "Safety Men," which have been created on this road. We need Safety Things, but we must have Safety Men. No railway is prosperous enough to afford keeping the chance taker on the pay roll.

Oil Burners.

Owing to the limitation in the supply of crude oil and its consequent increased cost in districts where it has heretofore

been available as locomotive fuel, the progress in equipping engines to burn oil has not been as great during the last few months as during corresponding periods of previous years. A saving in fuel bills is, however, still possible in districts where coal is being used. One railway, the Chicago & North-Western, has recently completed the equipment, for oil burning, of all locomotives running in and out of Omaha, Neb. Tank facilities have been constructed in the upper yards at Omaha, with a capacity of 210,000 gallons.

Tests conducted by the North-Western on the Omaha-Norfolk division, from Norfolk to Chadron, a distance of 327 miles, showed a consumption for the entire distance of 3,000 gallons. This is the capacity of one tank, and thus five stops for fuel were eliminated. Saving in time and in fuel expenditure is expected from the change. A major consideration is, however, the elimination of fire risk on the western prairies incident to the use of fuel oil. The changes in equipment are simple and include the insertion of the necessary burner and connections in the firebox and the construction of an oil tank in the space formerly occupied by the coal supply.

THE JURISDICTION of G. W. Wildin, mechanical superintendent of the New York, New Haven & Hartford, has been extended to cover the maintenance of electric locomotives or multiple unit cars, and the operation and maintenance of power stations up to and including the lines at the crossarms outside of the switch house. This is typical of the trend of work in the mechanical department today. It is up to mechanical officials to familiarize themselves with electric operation, for as time goes on, more and more work of this character will come under the jurisdiction of the mechanical department.

GASOLINE.

Gasoline, George Fitch tells us, according to "Graphite," was originally used only for cleaning gloves and ejecting hired girls through the kitchen roof, but has now been taught a great variety of interesting tricks, such as running automobiles, aeroplanes, motor boats, windmills, street cars, hearses, corn shellers and bicycles.

By the aid of gasoline we can travel sixty miles an hour through the air, 150 miles an hour over the land and six feet into the ground with the greatest ease.

A gallon of gasoline can do as much work in an hour as a horse can do in a day, and it doesn't have to be fed and bedded down at night. It can drive an automobile twenty miles, and while doing this can cause three runaways, a collision, a $20 fine for speeding, a divorce suit and an inquest.

A gallon of whisky at a Saturday night dance can cause a great deal of trouble, but it is tame and kittenish beside a gallon of whiz-water which is conducting a joy ride.

Gasoline is a clear, nervous liquid which is composed of speed, noise and trouble in equal parts. It is made of kerosene reduced to a more violent stage and is kindly supplied to the restless portion of mankind by the fragments of the late Standard Oil Company.

THE MAN WHO WINS.

The man who wins is an average man;
Not built on any peculiar plan,
Not blest with any peculiar luck;
Just steady and earnest and full of pluck.

When asked a question he does not "guess"—
He knows, and answers "no" or "yes;"
When set a task that the rest can't do,
He buckles down till he's put it through.

Three things he's learned: that the man who tries
Finds favor in his employer's eyes;
That it pays to know more than one thing well;
That it doesn't pay all he knows to tell.

So he works and waits; till one fine day
There's a better job with bigger pay,
And the men who shirked whenever they could
Are bossed by the man whose work made good.

For the man who wins is the man who works,
Who neither labor nor trouble shirks,
Who uses his hands, his head, his eyes:
The man who wins is the man who tries.

—*Pere Marquette Monthly Magazine.*

AUTOMATIC COUPLERS IN FRANCE.

By Thomas Reece.

An interesting competition was recently arranged in France by the Ministry of Public Works and prizes were awarded for the best systems of automatic couplings. The couplings were required to fulfil the following conditions: (1) To allow of the retention of the existing side buffers of carriages and wagons; (2) to comply with the international requirements in force concerning rolling stock crossing the frontiers, and in particular to leave sufficient free space to assure the safety of the shunter in cases where a carriage with the automatic coupling is to be attached to one fitted with the system at present in use; (3) to provide a safety coupling which will come into use should the automatic coupling break; (4) to couple up carriages easily and securely even when they come together gently, without the necessity of bringing them to a standstill or of the shunter going between them; (5) to permit uncoupling by one man standing outside the buffers on either side of the carriages; (6) to allow of shunting operations after uncoupling by enabling the unseparated carriages to be moved without automatically coupling up again; (7) to support a pull of at least 32,000 lbs. on the draw-hook; (8) to be secure against danger of unhooking in case of compression between carriages; (9) to be of simple and solid construction, avoiding if possible the use of the endless screw, tooth-wheel gearing, springs, or any delicate mechanism; (10) to allow for existing connections for automatic brakes, steam heating and lighting, as well as for through passages in corridor trains and to be compatible with the working of the continuous brake on goods trains.

The number of entries for the competition was considerable and the committee appointed to examine the automatic couplings made special reference to the fact that it was compelled by the first of the conditions to award the prizes only to couplings permitting the retention of existing side buffers. Its report also stated that the awards had been made to those couplings which complied most fully, from the theoretical standpoint, with the conditions laid down by the Ministry of Public Works and which from the practical point of view presented no obvious defects such as complicated construction or the use of fragile parts; but it must not be concluded that because an automatic coupling had received an award or honorable mention it was qualified for immediate adoption under practical working con-

ditions on trains without undergoing further thorough testing in the workshops.

The first prize of 5,000f. was awarded to the Pavia-Casalais automatic coupling, the second of 3,000f. to the Piedana, and the third of 2,000f. to the Moyer and Bouvier coupler.

The committee considered it its duty to indicate that the automatic coupling, the second of 3,000f. to the Piedana, and superior to those classed second and third. In addition to the three awards eight inventions were deemed worthy of special mention, and the committee stated that a number of the couplings, while having defects rendering them impracticable in their present form, yet showed remarkable ingenuity.

Special praise was accorded to the Laycock automatic coupling, which is used to a considerable extent in England, but in view of the fact that it provides for the retention of side buffers only during the initial period of its adoption the committee regretted that it could not be admitted to compete under the conditions laid down for the tests.

CAR EFFICIENCY.*

The leading newspapers and magazines, for months past, have been full of articles on "Car Efficiency' 'and "Car Shortages." Suggestions and advice, enough to fill a library, have been offered. The inequalities of car interchange still continue. Railroads have exhausted every means at their command to get their cars, or the equivalent, returned, but little or no success has crowned their efforts.

The American Railway Association at one time raised the per diem rate to 50 cents. An inequitable penalty rule was enforced for a while, but was eliminated after proving its futility.

In the case of the Illinois Central-Missouri Coal Company, the Interstate Commerce Commission ordered the railroads of the United States to form themselves into one national system. In response thereto, the American Railway Association appointed a commission to investigate and report on a plan to carry out the intent of the Interstate Commerce Commission. The committee reported to the American Railway Association, which resulted in the creation and adoption of per diem rule 19 and car service rules 1, 2, 3 and 4. These rules, I am afraid, cannot entirely bring about the much needed reform.

The first essential toward a solution of the problem must be based on equity and fairness. Such a condition will only obtain when we eliminate the old theory that we must retain authority over our cars when beyond our own rails. When we publish through rates and routes we practically pool the instrumentalities of transportation necessary to maintain and keep open such routes.

The language of the Interstate Commerce Commission in the Missouri Coal Company case already referred to, means "pooling" if it means anything. If it can, by a stretch of the imagination, be otherwise interpreted, then "what fools we railroaders have been." The absorption of a smaller road or a consolidation of lines has always meant the immediate re-marking of all cars with one common name or initials.

The larger railroad systems are composed of numerous divisions. If it is practicable and desirable to have freight cars in inter-road movement arbitrarily returned or moved, according to individual road ownership, then the same principle should also hold good as between divisions or parts of large systems and we should handle cars in a similar manner between divisions as the rules laid down require us to do between railroads. Such a proposition is not based on equity. It arbitrarily forces empty cars contrary to traffic, operating and trade conditions; it decreases the car supply and efficiency; increases empty car movement and switching; retards filling of car orders; fails to equalize car interchange or exchange; and, above all, relieves the co-partners or connections from any obligation to furnish any portion of the equipment to operate through routes in which they participate in the revenue. It puts all the burden on the originating road; increases the cost of operation and accounting in the details of its working, with no corresponding benefits.

The rules permit of manipulation in loading cars to or toward home, so that the greater portion of the local traffic probably will be cared for with foreign cars. Their indefiniteness is admitted by the creation of a commission to carry them out and determine the merits in each case.

I have given the subject of car interchange much study and thought. What we must come to, in my opinion, is a clean-cut arrangement that will be automatic and simple in its operation and application; one that needs no commission to pass judgment on or determine who is guilty and the measure of such guilt. It must be such as to distribute pro-rata among the beneficiaries the obligation to furnish cars for the traffic in which they participate. It makes co-operation the necessary means to success. The ideal plan, automatically, shall show, with one set of figures, the exchange balance and the car hire balance, thus eliminating our present expensive and unsatisfactory per diem accounting system. It will also prevent, during periods of car surplus, the originating roads from forcing its cars on to connections, and refusing to accept other cars for return loading.

In my proposed scheme, each road controls its own quota of cars, equal to equipment owned, and if any connection is delinquent, each road can penalize such debtor road until it pays up.

My idea is to organize a clearing house, under the jurisdiction of the American Railway accounting officers, for simply keeping and clearing the accounts. Pool all the box cars, or make special pool of special cars, if necessary. Have the exchange of cars the basis of interchange and settlement for car hire. Every road must, for its own protection, make an honest effort to equalize or pay the penalties for failure to do so. If not equalized in a specified (agreed) time, an additional rate per day plus the per diem rate will accrue, until a second (agreed) period when the penalty rate still further increases.

The penalty is positive and simple in its application and accounting, and cannot be evaded. The plan would be as follows:

Take a complete inventory of every railroad car on hand, also a statement of all cars owned, and location, say, of date 12:01 A. M., July 1, 1913. Each road will be credited with all cars in its equipment and debited with all railroad cars on its line. All railroad cars delivered off are credited and all railroad cars received are debited, and the net balance each day determines such road's debit or credit. At the end of the month, settlement is made on the total net debit or credit.

Have the penalty automatically apply at two different periods —a graduated rate, thus: "A" notifies its connections July 1 that it wants debits equalized; say, 15 days after date, the penalty for failure to do so will be 25 cents per car per day in addition to the per diem rate. If not equalized by July 30 (the second period) the rate will be 50 cents per day plus the per diem rate.

If any road cannot equalize because its connections do not even up, then such road may penalize its delinquent connections to offset.

The expense eliminated, on account of per diem accounts, discrepancies, correspondence account of disputes, reclaims, etc., will not only take care of the clearing house expense, but be a net saving.

In cases of errors or omissions, debit or credit slips to be signed by both roads, will pass current and be taken into account on date reported, with proper allowance back to date of error.

Each road deals only with its immediate connections. With such an arrangement put into effect, I believe it will come nearer an equitable adjustment or distribution than any yet presented. This scheme eliminates reclaims of every description.

*Extracts from a paper before the St. Louis Railway Club by Jos. R. Cavanagh, superintendent freight transportation, New York Central Lines, Indianapolis, Ind.

Locomotive Repair Shops

A Symposium

AN ANALYSIS AND DISCUSSION OF THE MORE IMPORTANT ITEMS RELATIVE TO THE CONSTRUCTION AND OPERATION OF REPAIR SHOPS.

By F. F. Gaines, S. M. P., Central of Georgia Railway.

The first essential in the construction of a railway repair shop is the location. This frequently is governed by the ownership of a piece of property or the ability to buy cheaply, without due consideration to other very important factors. Frequently, on account of these reasons, plants are built outside of the residence districts, requiring employes to ride long distances on street cars, or work trains. If at all possible this should be avoided. The getting of the best class of labor is very essential, a long ride twice a day is very objectionable, and where there is a demand for this class of labor by industries or other shops, the outlying shop only obtains the undesirable culls; and not always is it able to obtain even this class of labor in sufficient quantities. It would seem as if a location where there is a good labor market was the first consideration in selecting a site. Due consideration having been given to this factor, the site should be such as will be convenient from an operating standpoint, in relation to divisional terminals, yards, etc.

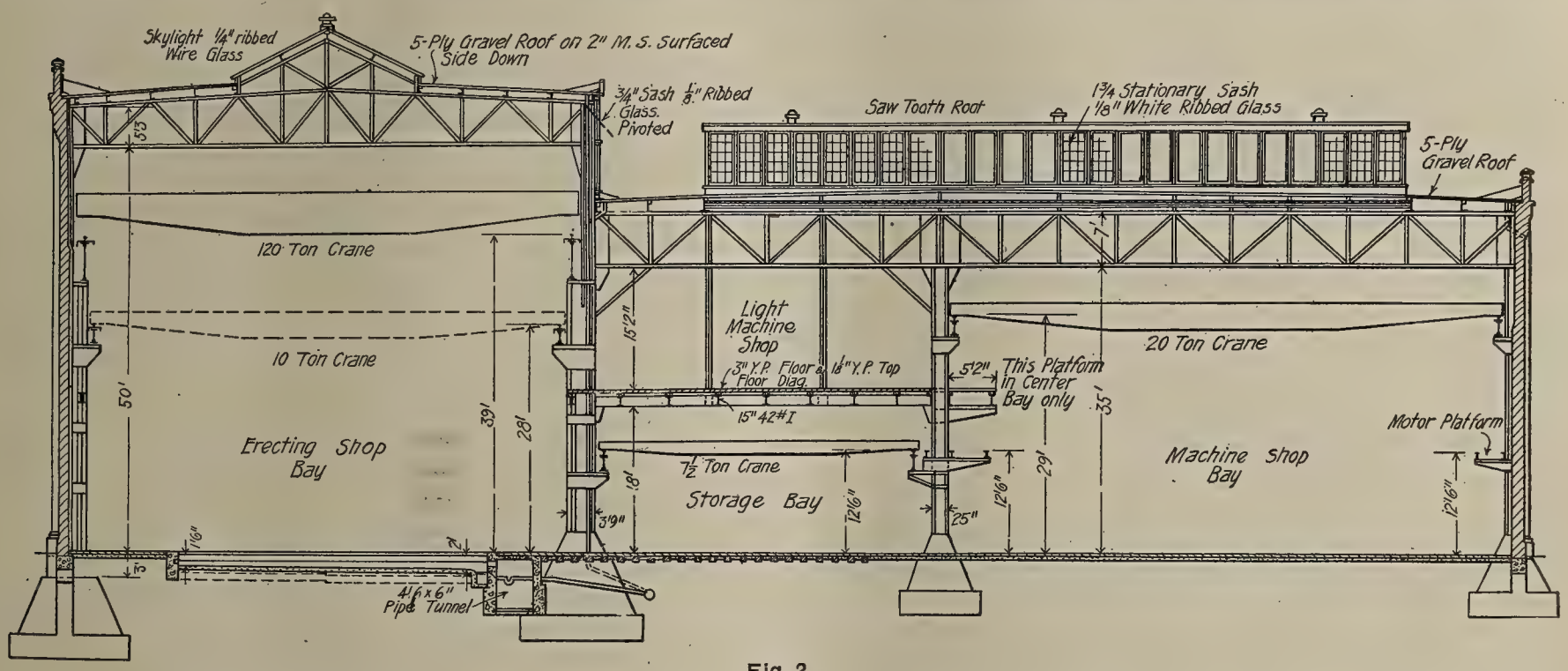

Skylight 1/4" ribbed Wire Glass
5-Ply Gravel Roof on 2" M. S. Surfaced Side Down
3/4" Sash 1/8" Ribbed Glass. Pivoted
Saw Tooth Roof
1 3/4 Stationary Sash 1/8" White Ribbed Glass
5-Ply Gravel Roof
120 Ton Crane
10 Ton Crane
20 Ton Crane
Light Machine Shop
3" Y.P. Floor & 1/8" Y.P. Top Floor Diag.
15" 42# I
5'12"
This Platform in Center Bay only
Motor Platform
Erecting Shop Bay
7 1/2 Ton Crane
Storage Bay
Machine Shop Bay
4'6" x 6" Pipe Tunnel

Fig. 2.

Type of Erecting Shop.

In the laying out of a repair plant the type or character of the erecting shop controls the general arrangement of buildings and tracks. It is essential to determine the type first, on this account. There are three general types, each with various modifications, which are generally used. The longitudinal with tracks running lengthwise of the shop, the cross shop with tracks and pits at right angles to the long axis of the shop, and the herring bone with tracks on the bias.

The longitudinal shop requires two cranes of medium capacity to lift an engine from the thoroughfare track to the pit tracks, and to wheel. Whenever this class of work is being done a large part of the crane equipment is tied up. The moving of material from other departments at right angles to the working axis involves more handling and time. The supervision is not as good, and it is harder for foremen to keep in touch with the work and oversee their men. The space between tracks must be sufficient to allow of standing wheels that are to go back under the engine, and are to have driving boxes fitted up, etc., this takes much floor space in an expensive type of building. If this floor space between tracks is not left for this purpose, the engines must be wheeled and finished on the thoroughfare track, partially or wholly blocking same. In a majority of longitudinal shops there is little provision for storing strippings, which either lie on the floor or are carried away to distant racks.

In the herringbone type the cranes required are similar and it is no improvement over the longitudinal shop in this respect. The movement of material and supervision is better. It does permit of the boiler shop crane runway extending through and handling of boilers by the boiler shop crane. There seems to be no advantage of this type over the cross shop, and the disadvantage of more awkward handling of engines and the use of two cranes for accomplishing this.

In the cross shop there is only one heavy crane required for moving and wheeling engines, and with an auxiliary high speed hoist, it can also be used for general service. With a lower runway, light capacity high speed cranes can be used for general work, making the best arrangement for handling both engines and general work. The lower runway may be continued through the boiler shop so that the boiler shop crane can handle a boiler from the frame in the erecting shop to the boiler shop. This arrangement also provides for handling all flues from and to the boiler shop. It should also be noted that an engine can be lifted both safer and quicker with one crane and one operator. The engines can be moved in and out at will without disturbing the other engines or interfering with work. The cross shop with a lower craneway through the boiler shop allows of a less expensive type of building, lower in height and less steel for cross supports and runways, by using a separate building for boiler shop, instead of continuing the erecting shop construction for the boiler shop, as is generally done in the longitudinal type.

The analysis of the three available types seem to show the superiority of the cross shop. With it should go a storage bay between the erecting shop and machine shop (see figures 1 and 2). This to be equipped with light capacity floor operated cranes for lifting and moving driving wheels, driving boxes, etc. The space between tracks in this bay is to be used as storage pits for strippings and repaired parts till needed. The tracks themselves, which are extended through from the erecting shop, are to be used for storage of driving wheels and engine trucks. This gives a legitimate space for this class of material, keeps it out of machine and erecting shops and provides a place for fitting up this class of material, and having it in readiness to run under the engine when it is ready for wheeling.

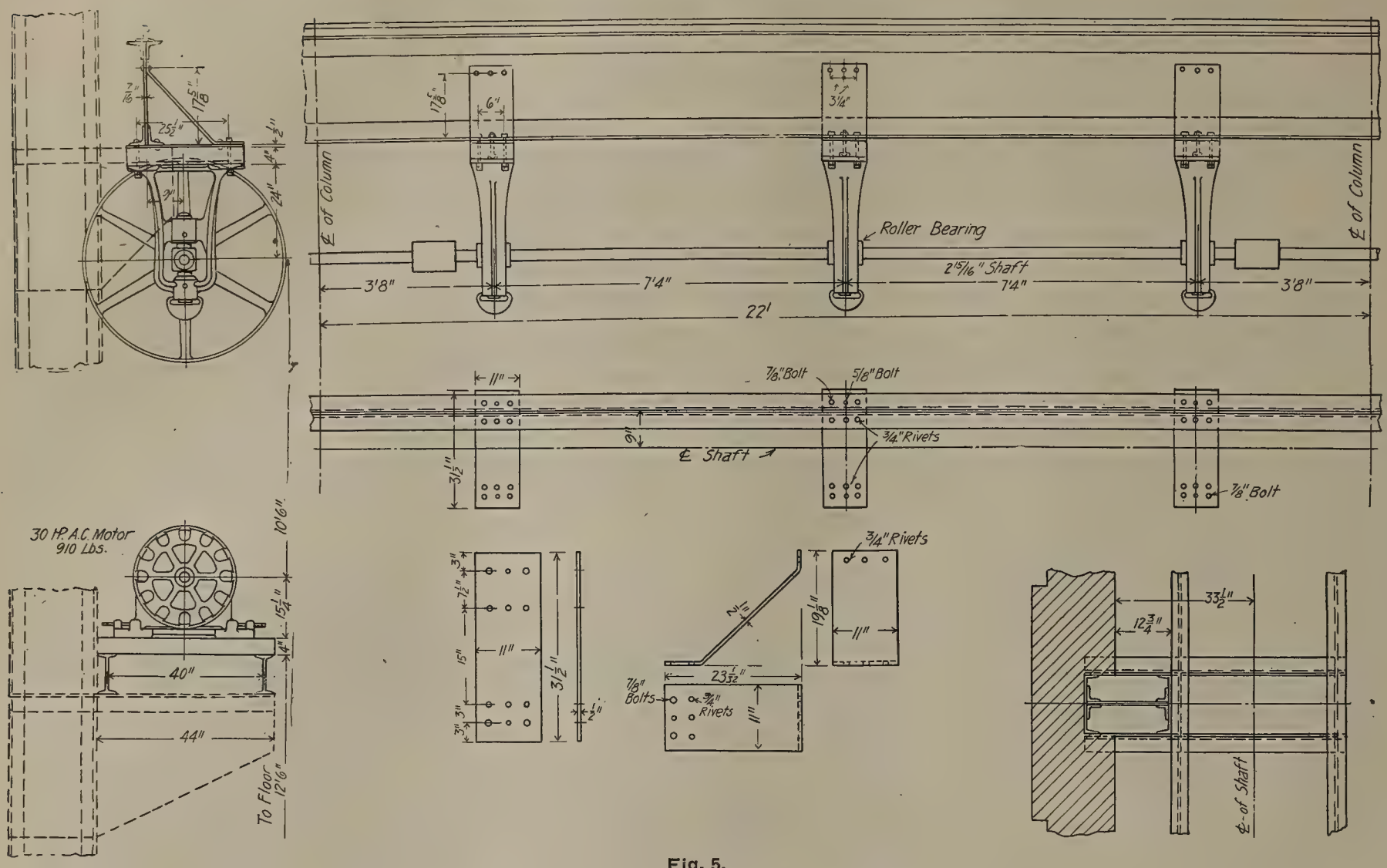


Fig. 5.

After experience with various types of shops on different railways the manifest advantages of this arrangement are, to me, unquestionable. As the cranes and runways are low and light, there can be superimposed a second story floor, which can be used for tinshop, heating and ventilating fans, apparatus for electric welding, brass work and air brakes, lubricators, injectors, turret lathes, etc. The second floor should be served by electric elevators of light capacity in addition to stairs. For heavy material, machines, etc., a platform may project out under machine shop crane runway and machine shop cranes used for serving the second floor in this bay. (See figure 2.)

Pits.

The number of pits required must be determined by the present and probable number of engines to be handled, although it should be borne in mind that with sufficient machine tools and capacity in the machine shop, so that standard parts are worked up and

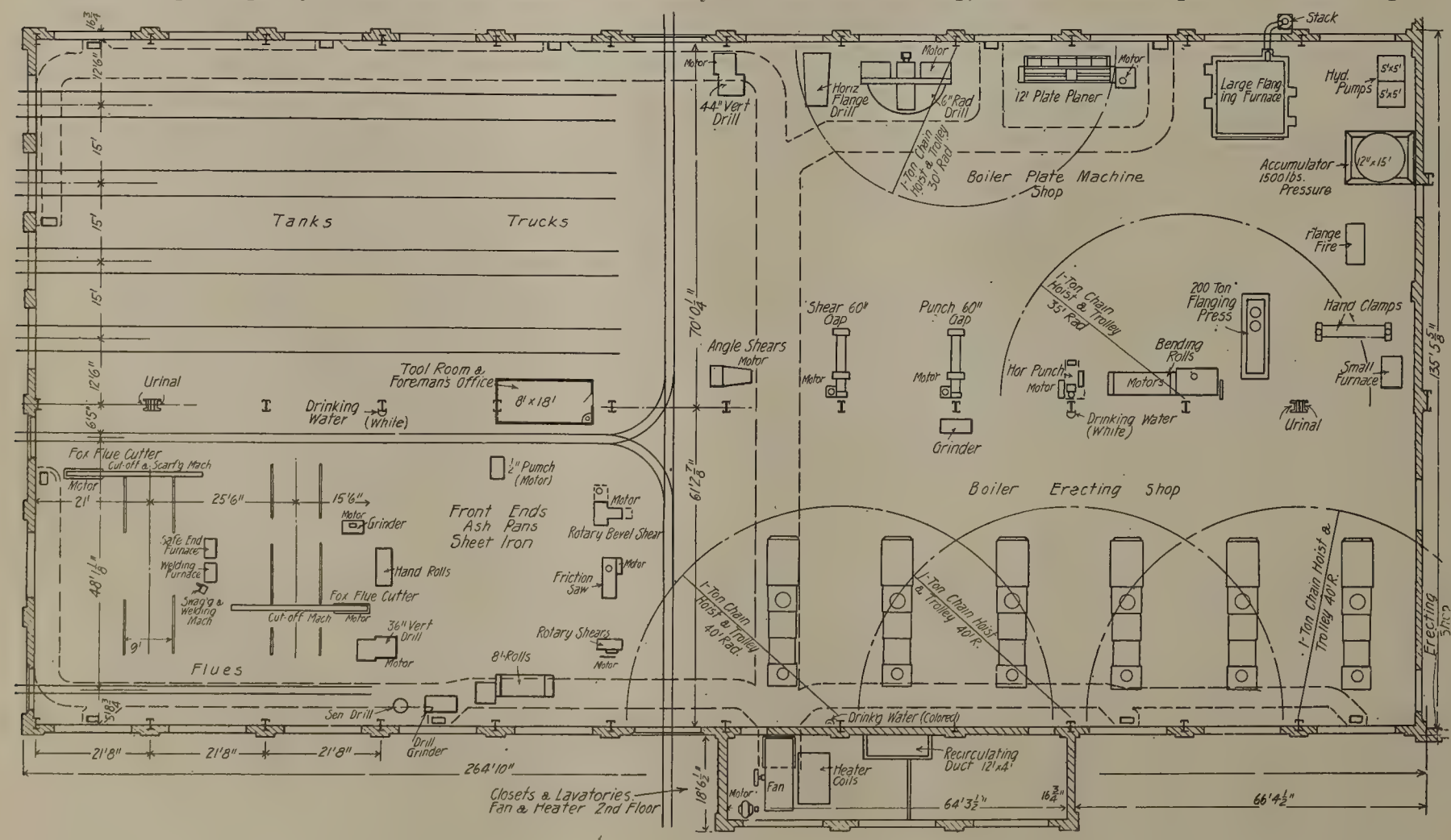


Fig. 6.

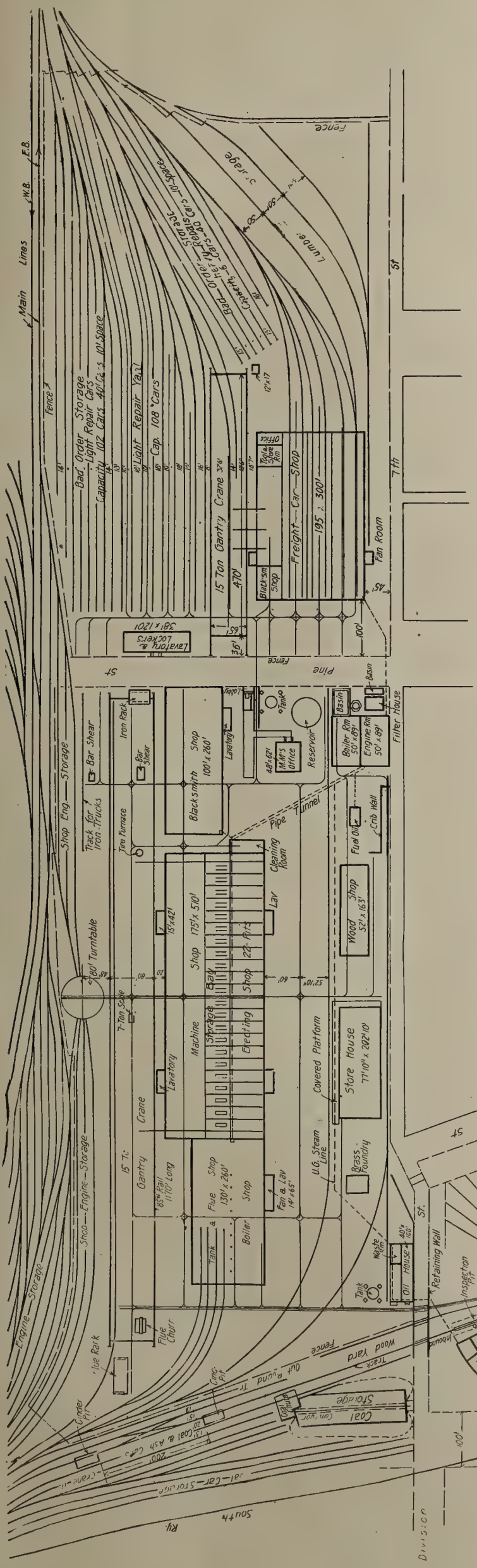

Main Lines
W.B.
E.B.
Fence
Bad Order Storage
Light Repair Cars
Capacity 102 Cars 40 Cars 10' Space
Light Repair Yard
Cap. 108 Cars
Bad Order Storage
Capacity 102 Cars 40 Cars 10' Space
Lumber
Storage
15 Ton Gantry Crane 3'6"
470'
Freight Car Shop
195 x 300'
Blacksm. Shop
Tool Room
Office
Fan Room
Lavatory & Lockers
38' x 120'
Pine Fence
Bar Shear
Iron Rack
Bar Shear
Shop
100' x 260'
Lavatory
Tanks
Reservoir
48' x 62'
M.M.'s Office
Boiler Rm 50' x 89'
Engine Rm 50' x 89'
Basin
Filter House
Blacksmith Shop
Pipe Tunnel
Fuel Oil
Crib Wall
Track for Iron Trucks
Tire Furnace
Shop Eng. Storage
60' Turntable
7-Ton Scale
Shop
175' x 510'
Machine Shop
Erecting Shop
Lavatory
Cleaning Room
Wood Shop
52' x 163'
Store House
77'10" x 202'10"
Covered Platform
Crane
Gantry
15 T.
Flue Shop
130' x 260'
Boiler Shop
Tank
Fan & Lav
U.G. Steam Line
Brass Foundry
Waste
Oil House
Retaining Wall
Inspection Pit
Repair
Wheel Storage
Wheel Pit
Machine Shop Tool Room
Hawthorne St.
Engine Storage
Shop Engine Storage
Flue Churn
Flue Park
Cinder Pit
Wood Yard
Out Round Tr.
Coal Storage
Coal Chute
Coal & Ash Cars
Tool Car Storage
Crane
Round House 32 Stalls
Division St.
Scale
0 50' 100' 150' 200' 250'
N

Fig. 1.

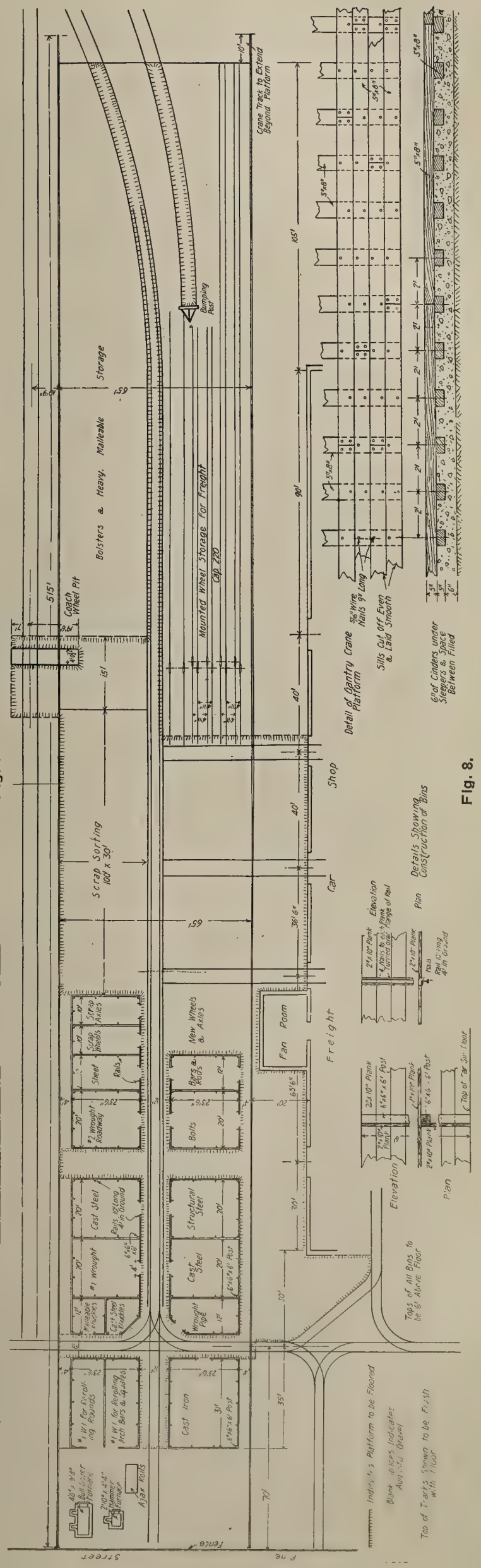

Crane Track to Extend Beyond Platform
Bumping Post
Bolsters & Heavy, Malleable Storage
Mounted Wheel Storage For Freight Cap. 220
Coach Wheel Pit
Detail of Gantry Crane Platform
5/8" Wire Nails 9" Long
Sills Cut off Even & Laid Smooth
6" of Cinders under Sleepers & Space Between Filled
Scrap Sorting 100' x 30'
Shop
Car
Freight
Fan Room
Strip Axles
Scrap Wheels
Sheet Rails
#2 Wrought Roadway
New Wheels & Axles
Bars & Rods
Bolts
Cast Steel
#1 Wrought
Rails Notched 4" in Ground
Structural Steel
Wrought Pipe
Cast Iron
#1 W. for Rerolling Rounds
#1 W. for Rerolling Mch Bars & Squared
Ball Driver Furnace
Hammer Furnace
Ajax Rails
Street
Fence
Pine
Elevation
Plan
Details Showing Construction of Bins
Tops of All Bins to be 6' Above Floor
Indicates Platform to be Floored
Blank Spaces Indicate Ash'd Gravel
Top of Tracks Shown to be Finish w.th Floor

Fig. 8.

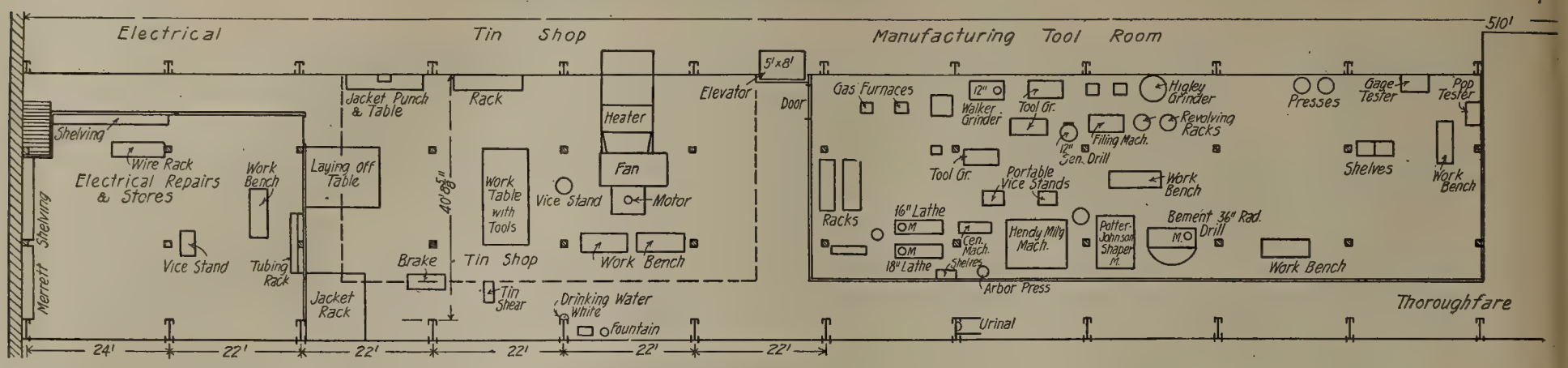


Fig. 4.

in readiness, and other work can be handled promptly, a much less number of pits are required than is generally figured. There was one road that built a shop with 72 erecting pits, but the area of the machine shop only allowed of a tool equipment sufficient to handle 48 pits, the remainder were simply used for storage of engines waiting for repairs. If erecting pits are to be used for this purpose only considerable investment in the building for erecting can be saved by cutting down the number of pits to those actually required. On the other hand, it is false economy to space the pits so closely that there is not sufficient room to allow of vise benches between pits, with room to work on engines without interference. It is expensive to have to carry bench work any distance from point of application, let alone the loss in time. To provide for such an arrangement of pits, the spacing of pit centers should be about 22 feet; and end pits, center to wall 13 feet. As to width of erecting shop, where a storage bay is used for wheels, etc., it is probable that except for Mallet engines, 60 feet is ample for present power; but in view of the growing size of power, in planning new shops it would be better to make the width 65 or 70 feet. Depending on the width, the floor space per pit would run from 1,391 square feet for a 60-foot width, to 1,623 for a 70-foot width. The pits in erecting shop should be provided with connections for electric light wires; power connections for portable motors used in setting valves, facing valve seats, boring out piston valves and cylinders; air for all pneumatic tools; steam and water.

Cranes.

The upper crane runway on account of lifting engines over each other must be high enough to give the necessary clearance. The lower runway for light capacity cranes should be high enough to carry the largest boiler over the highest engine, and be a continuation of the boiler shop crane runway. At the opposite end of erecting shop from the boiler shop, is the most available site for the lye vats and cleaning room. This may be made an annex to erecting shop with a 12-foot high wall between, and the lower runway etxended so as to give crane service. This arrangement provides prompt handling of stripped parts between pits and cleaning room.

Machine Shop.

The first consideration in the machine shop is area or floor space. Many shops are in existence without sufficient floor space to accommodate the equipment required to operate the erecting side. As a consequence, tools are not arranged to proper advantage, they are crowded, much time and money are lost in handling material. Notwithstanding the advent of high speed steel and consequent increased capacity of machines, there is probably no one feature that is oftener overlooked or misjudged than that of sufficient machine shop floor space for economical operation, and balancing of requirements of the other departments. It would seem that a minimum of 2,500 square feet per erecting pit should be allowed and that even as high as 3,000 feet per pit would not be excessive and within the limit of economical first cost and operation. From observation and experience, I am convinced that the best tool arrangement is one that provides in each group the tools necessary for all the work of that group, so that raw material, when it starts, is finished within the group area. This may result at first in a few machines being idle part of the time while the shop is growing up to its capacity, but the interest and depreciation on the tools is much less than labor cost and loss of time where material must be moved backwards and forwards, due (see figures 3 and 4) to lack of tools or poor tool arrangement. In this scheme of arrangement each class of work is a self-contained unit, the raw material is delivered to it, and leaves it ready for use. The crane equipment should be sufficient for all general transfer work, and the overhead crane of sufficient capacity for lifting and placing the machine tool equipment. By getting in the cranes as soon as the building is roofed, a large initial expense in unloading and placing machinery can be made, as well as an enormus saving in time. The overhead cranes, however, should not be depended on for serving individual machines, as in this event important work in other departments will be seriously delayed while the crane is tied up for this purpose. For handling work to machines, a system of wall cranes should be installed to take care of the larger machines and tool groups. Those serving wheel lathes, axle lathes, wheel presses, tire boring mills, etc., should be equipped with floor controlled electrical hoists; those for lighter work, with air hoists. The floor-controlled crane has the further advantage in placing heavy work in machines of being more easily controlled and operated, and consequently quicker than overhead cranes for this purpose. A margin around all thoroughfares and tracks should be maintained at all times, and under no circumstances should material be allowed inside these limits. To distinctly mark these limits, it has been found very satisfactory to imbed partially in the floor galvanized telegraph wire, stapling it at intervals. This keeps bright, does not wear, and needs no furtner attention after original application. The necessity for keeping thoroughfares clear at all times, both on account of personal injuries to employes and handling of material, is too evident to require further comment.

In most cases there will be a small proportion of belt-driven tools, in which case line shafting can be provided by hanging shafts to underside of crane runways (Fig. 5), with a parallel line of supports half way between line shafting and tool drive for support of motors and countershafts. By keeping all belt-driven tools close to wall or side of bay, the belting is out of the way of cranes and inconspicuous.

Boiler Shop.

As intimated when discussing the various types of shops, it is desirable to have the boiler shop next to the erecting shop. A wall between the two shops about 12 feet high is desirable, to separate the departments and minimize unnecessary visiting. The crane runway should be a continuation of the lower runway in erecting shop, so that the boiler shop crane can enter erecting shop, remove boilers and flues to boiler shop and return same. This arrangement minimizes handling between these departments. The area of boiler department, including flues, tanks, etc., is generally too small, resulting in having to handle considerable tank repairs out of doors. There should be not less than 1,500 sq. ft. of floor area for each erecting pit, and prefer-

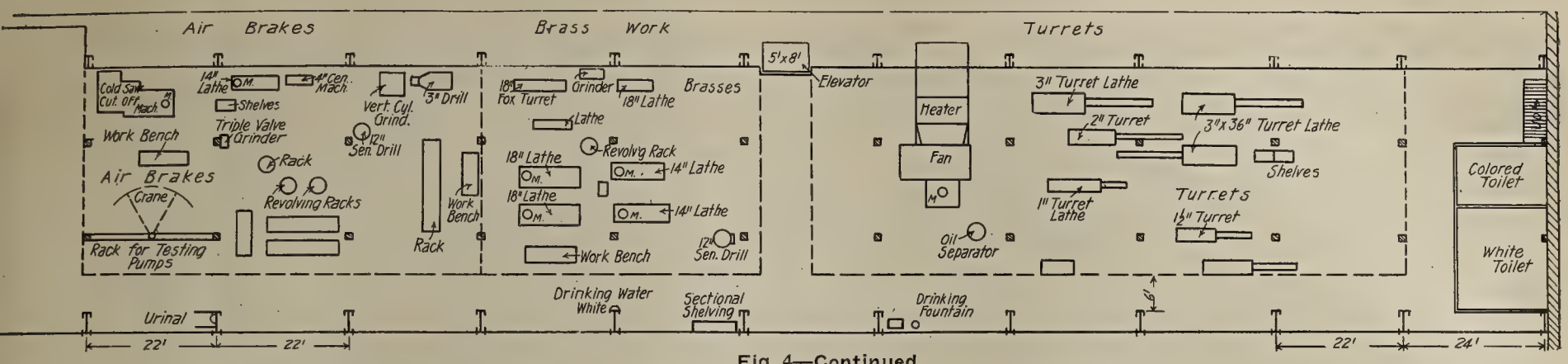


Fig. 4—Continued.

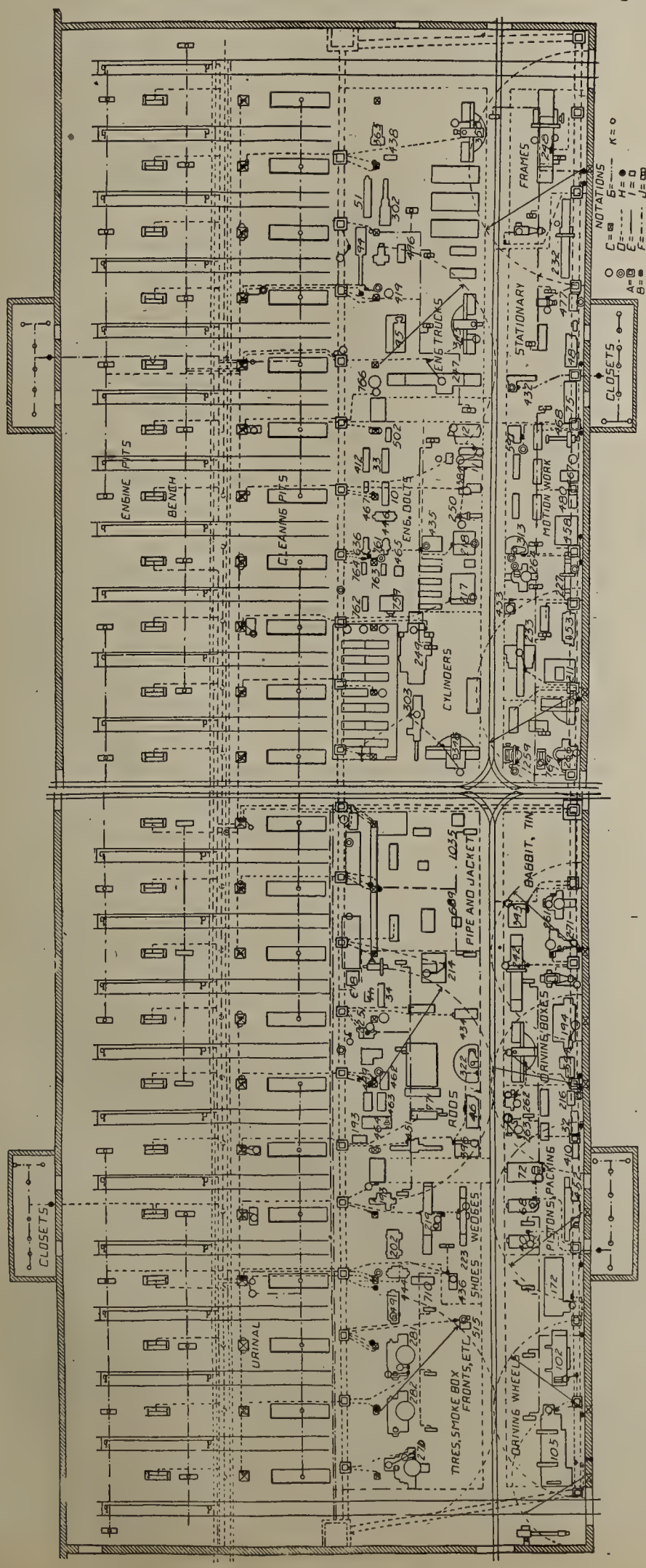


Fig. 3—Plan of Machine and Erecting Shop, Central of Ga. Ry., Macon, Ga.

ably 2,000 sq. ft. A study of the tool arrangement in this department will also be profitable, grouping tools for the work they are to do, to save rehandling of material (see Fig. 6). As in the machine shop, there should be individual wall cranes for the heavier tools, and over the boiler erection floor, to prevent undue use of overhead cranes.

The blacksmith shop should be located so that the thoroughfare should be a continuation of that in the machine shop, to provide for rapid and minimum handling of material. The floor area should be based on about 1,200 sq. ft. per pit of erecting shop. This, however, will have to be increased or decreased, depending on the amount of car forgings handled. The proper grouping of tools to save unnecessary handling of material will be found advantageous. With heavy fires located in reach of thoroughfare, and served with individual cranes, it is doubtful if the use of traveling cranes is warranted (see Fig. 7). In addition to bar shears in vicinity of iron racks, a punch, shear, and drill press should form part of the tool equipment. With them a great many forgings can be completed for car department without further handling, leaving in a finished condition for storeroom or repair tracks.

One of the most essential requirements for economical operation is a place for heavy material, where cars can be unloaded by cranes, and which will be so located as to feed to each department where required. This is best accomplished by a material platform running parallel to, and at least as long as, the plant. It is preferable to have a space between it and the buildings, as where the buildings are used to support one track of a crane runway, on account of its proximity, there is more chance of personal injuries (see Fig. 1). In some cases such a platform is served by an overhead crane, running on a skeleton steel runway. This, however, is more expensive and no more efficient than a gantry crane using rails at either side of platfrom for a runway. The gantry has the further advantage of being cheaply moved if circumstances arise that make a change of location desirable. On such a platform can be stored and assorted, using a magnet in connection with the crane, all scrap, castings, cylinders, wheel centers, tires, and boiler and firebox plate. For handling the latter, a different type of magnet is required from that used for scrap (see Fig. 8). This also makes a very convenient place for changing tires in connection with the crane, and an oil furnace for heating tires can be located opposite that part of machine shop where tire and wheel work is done.

Handling Material.

Another indispensable part of the plant is a system of handling material from department to department, from storehouse to shops, and from material platform to departments This is taken care of very nicely by a narrow-gauge industrial railroad of the Hunt type. If there is much work to be handled over any distance, the ordinary push cars may be supplemented by storage-battery locomotives. This railroad (see Fig. 1) should interconnect every department, storehouse, oilhouse, roundhouse, and car department. In view of recent developments in storage-battery trucks, it would seem as if they would serve this purpose better than the industrial railway system. With the provision of proper runways, they would be quicker and more flexible,

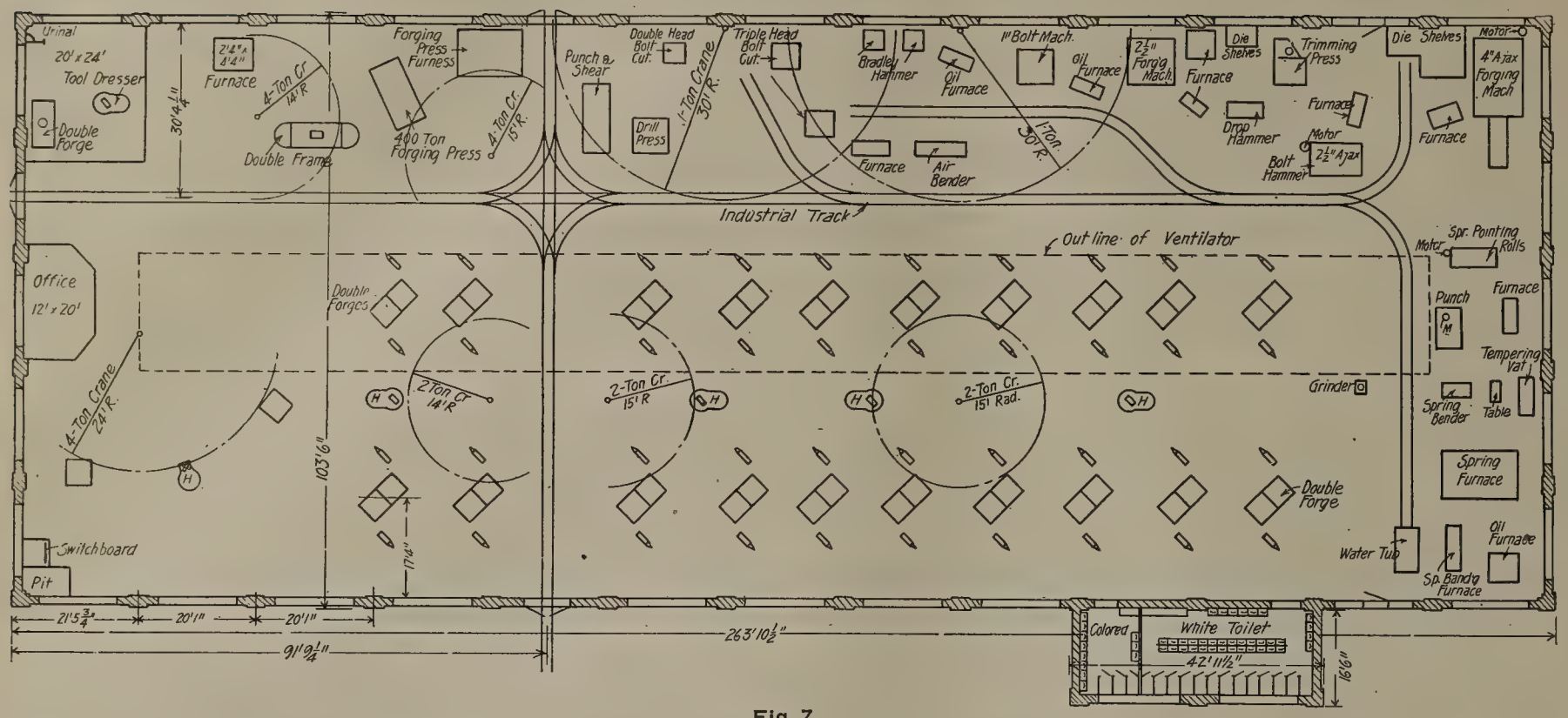


Fig. 7.

and considering the saving in time, would probably be equally as economical.

Heating, Lighting, Etc.

Proper heating, light, ventilation, and sanitation should be provided in all departments. For many reasons, the hot-blast system, utilizing exhaust steam, seems to best fit into the average plant. The ducts for air recirculation can be used also as pipe tunnels. In summer the fans may be used to circulate the air and make the shop more comfortable on hot days. For natural lighting, nothing equals indirect north light from a sawtooth roof. Direct sunlight is objectionable in almost every department, both as to the glare and, in the summer, the heat.

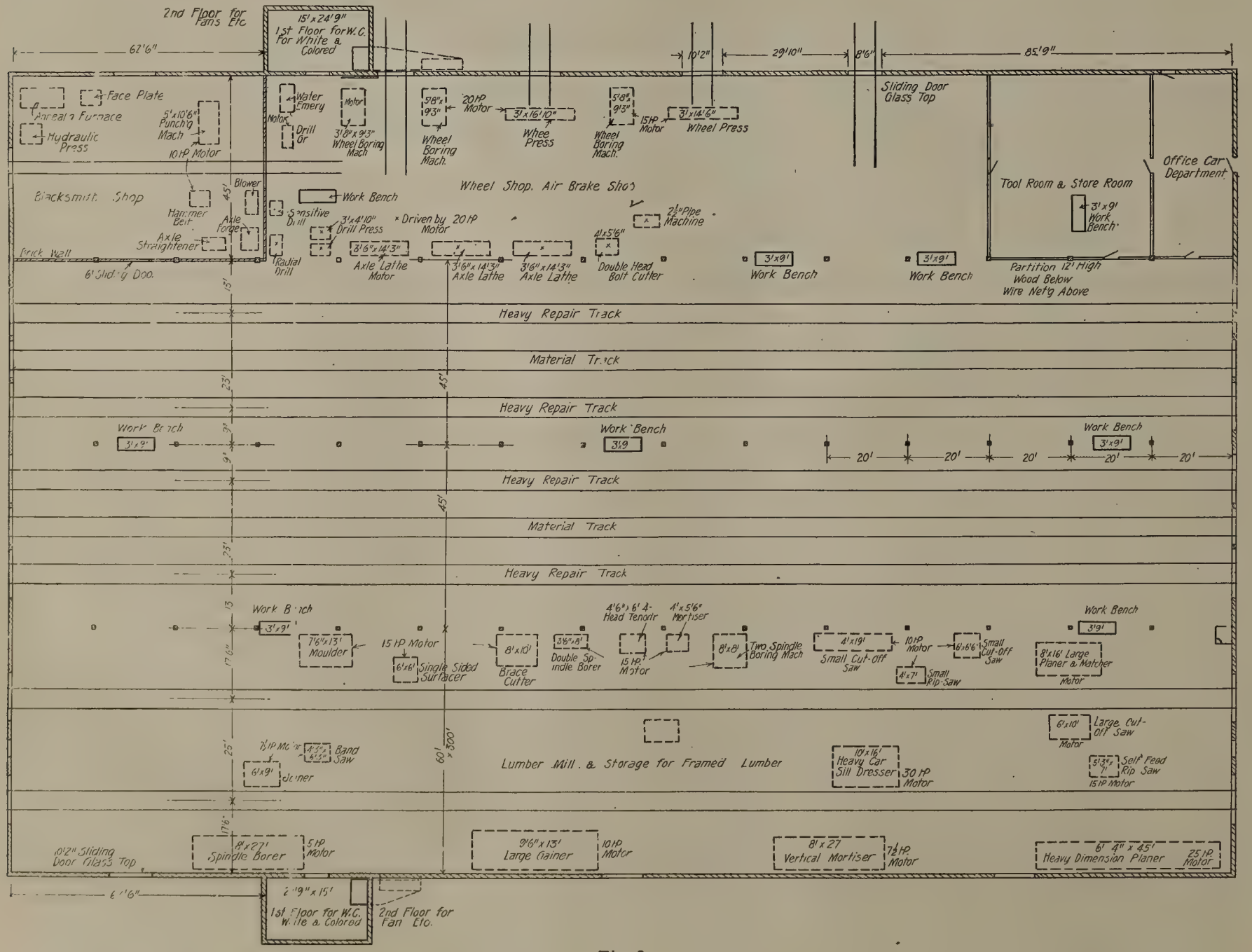


Fig. 9.

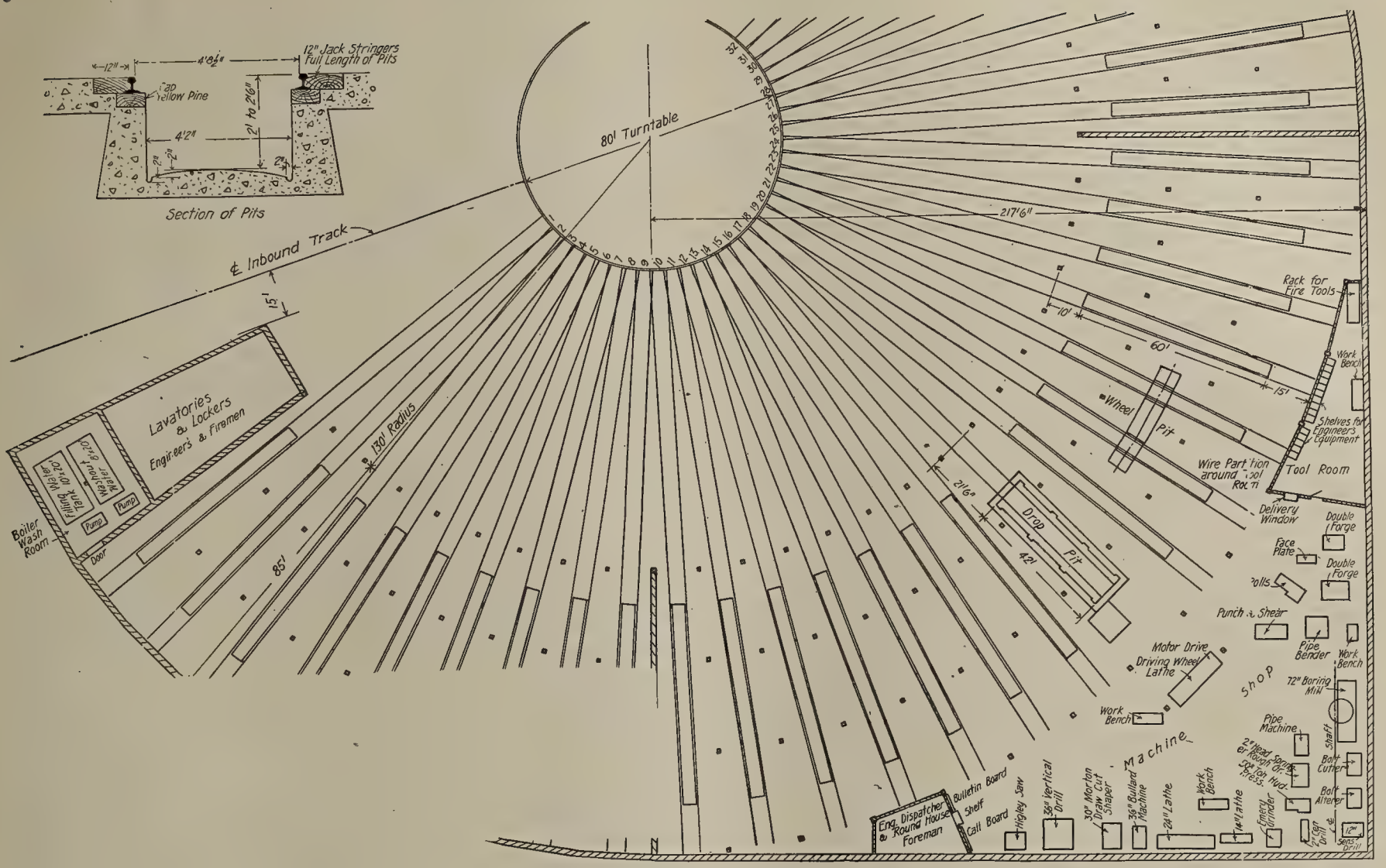


Fig. 10.

The windows should not come lower than seven feet from the floor, as outside happenings cannot then distract the attention of the workmen. The wall space under the windows can be used for clothes lockers, etc. For general illumination, flaming arc lamps are probably the best in high bays above the cranes, and tungstens for lower and more specific lighting. Closets, lavatories and urinals should be provided for every department and in the department proper, so that it is not necessary to leave the department for their use. To provide sanitary ice water in summer, it has been found very satisfactory to use bubbling fountains with automatic closing valves, the water, before reaching the fountain, passing through a coil of tin pipe on the bottom of an ice box. This gives, cool, palatable water without the extreme chill of ice water, and eliminates any contamination from the ice. Metal lockers with expanded metal doors should be provided for the workmen. The netting doors provide ventilation for the clothing and allows of inspection at any time.

Shop Floors.

The proper material for shop floors has long been a serious problem. Concrete abrades rapidly, becomes slippery from oil, and is objectionable to machine operators who have to stand on it. Wood laid lengthwise of the grain on any foundation is open to several objections. Hardwoods rot very quickly, and softer woods, such as yellow pine, wear and become rough in a short time. The most satisfactory floor in the experience of the writer is creosoted wood blocks laid endwise of grain and on a concrete foundation. This floor not only wears well but is not greatly affected by water. It is also sufficient foundation for all but the largest tools. In case of changing or adding machines, it is easy to remove a line of blocks, and install electric conduits. Where, by reason of wear or other cause, it is desirable to make repairs, it can be done cheaply and quickly. Waste from the car department mill can be cut up as it accumulates, and where a creosoting plant is available, flooring material can be accumulated at a slight cost.

Car Department.

The car department varies so much at any given location in its requirements that there is little to be said. That it is not necessary to have a close connection with the locomotive department is certain, and a certain amount of isolation is desirable. There should, in addition to the mill and machine department, be a small smith shop for reclaiming material, foreign car forgings, and reworking of bolts. There should also be enough track space under cover so that in stormy weather the repair track force can work on heavy repairs under cover.

The industrial railway system (see Fig. 1), gantry crane, storage platform, sanitation, heating, lighting, etc., apply equally as well to the car department as to the locomotive department. Time in arrangement of tool equipment can be spent profitably so as to minimize handling of material in and out of the shop (see Fig. 9).

Round House.

The round house as well as the car shop can be isolated from the locomotive department with advantage. Tool equipment necessary for all running repairs should form a part of the round house equipment so that all work may be done on the ground, and there is no reason for visiting between the round house and back shop. To provide space for the tool equipment, there can be a triangle formed by two tangents to the outer circle (see Fig. 10). This arrangement keeps all work under one roof and minimizes the handling of material, and greatly facilitates supervision. If an inspection pit with roof is provided on the inbound track, incoming engines can be inspected, and when no work is required may be turned and placed on standing tracks. By only housing such engines as require repairs or boiler washing, a small number of stalls will easily accommodate a much larger number of engines.

In General.

In this article the handling of all details involved in planning a shop has not been attempted, as it would extend it indefinitely, and only the main features have been attempted. The figures referred to are the plans of the Central of Georgia shops built at Macon and completed about four years ago, and illustrate the principal points under discussion. This layout also provides for doubling all departments in the future, when additional capacity is required.

DETERMINING THE TYPE OF ERECTING SHOP FOR LOCOMOTIVE REPAIR SHOPS.

By P. L. Battey, Vice President, The Arnold Co.

The arrangement or placing of the locomotives undergoing repairs in the erecting shop, is a question which has been much discussed by railway engineers, and motive power officials in charge of equipment. The design of the average shop in the past has been along two distinct lines, ordinarily known as the longitudinal, and the transverse types; in one the erecting pits being arranged length-wise of the building, and in the other cross-wise. A few years ago a "hybrid" type, known as the herringbone arrangement, was devised, under which plan the engine erecting pits are arranged diagonally. This, in fact, is a longitudinal shop with certain advantages obtained by the modifications, principally in the handling of flues.

The predominating design is undoubtedly the transverse shop, although there are numerous longitudinal shops of large proportions, and one large shop of the herringbone type.

Many railroad officials having shop operation in charge have rather strong inclinations toward one particular type of shop; this, no doubt, being the development of large experience with this particular type. Most of the larger shops which have been constructed within the last 15 years have received a great deal of study as to the industrial layout, not only with regard to the arrangement of the erecting shop, but of all tributary departments, separately, as well as collectively with the erecting floor.

To the writer's mind, the particular type adopted for an erecting shop is of far less importance with relation to its economic output, than the organization element in its operation. From all observations and data available it has been quite conclusively proven that it is quite as possible to operate a longitudinal shop economically as one of the transverse type, and undoubtedly the same is true of the herringbone type.

The factors very frequently of greater importance in the design of the erecting shop, than the handling of materials to and from the shop, and the matter of supervision, are the possibilities in the arrangement of the shop group on the site, quite often pre-determined upon before preparation of preliminary designs for the shops; the climatic conditions under which the plant will be obliged to operate; the size of the erecting shop for the immediate installation; and the probabilities of extension, both as to relation to the ultimate size of plant and the property requirements; and also the factor of great importance which is infrequently given full consideration, the "use factor" of the erecting shop overhead cranes, together with the necessary amplification of the building structure for their accommodation.

There undoubtedly have been combinations of the above factors resulting in decisions on transverse type of shops in preference to longitudinal, and vice versa. It is manifestly impossible to secure the necessary information for a direct comparison of the relative efficiency of the transverse and longitudinal types owing to these variable conditions. A fair comparison is not upon the relative advantages in the handling of materials from machine shop to erecting shop, of the ease and facility for supervision, but rather upon the overall annual cost of operation, including the value of real estate, and the investment and depreciation charges on plant cost.

Quite often the combination of repair shops with terminal facilities brings about decisions as to property location primarily favorable to the terminal facilities rather than to the shops. With dimensions of property frequently thus fixed the problem of the designer resolves itself into an analysis of the possible trackage and grouping of the tributary departments about the erecting shop, this grouping being largely controlled by the arrangement or type of the erecting shop. A cut and try method of elimination is the usual result, using the different types of shop. The adopted design is more frequently influenced by the estimated ultimate capacity of the shop than by the initial installation, as practice has demonstrated the advisability of providing for ample extension to plant. A longitudinal shop with floor and pit capacity in excess of about 40 engines becomes relatively very long for an economic shop grouping, particularly with reference to suitable yard and connecting trackage. For shop capacity of 40 to 70 engines undoubtedly the transverse type, with sufficient overhead clearance for double-decked traveling cranes, (the upper ones arranged to carry the locomotives overhead, the lower for service work in erection) is the most adaptable to the ordinary controlling conditions.

For capacities up to 25 or 30 engines, in certain latitudes, transverse shops with transfer tables frequently work out on an economical basis. For small shops, say with pit space for less than 10 engines, careful analysis is quite likely to indicate the economy of a local engine hoist or lift, with either transfer table or ladder track, for transverse shop; or turntable or ladder track, for longitudinal shop. In these smaller shops, unless there is strong probability of considerable increase in capacity, the operating cost of additional labor in handling is more than offset by the greater interest and depreciation charges upon cranes, building construction and additional power house capacity.

There have been numerous developments in the details of transverse shops as to the grouping of different classes of work; that is, providing practically separate departments for certain parts of the erecting shop work. There are several plants with separate stripping and wheeling departments equipped with separate cranes for this purpose, and there undoubtedly are many advantageous features under this arrangement, particularly in a fairly large plant where the supervisional expense is economically distributed. The writer has a rather strong inclination toward departmentizing both the machine and erecting shop, particularly the former. While this sometimes causes additional expense in tool equipment it is more than justified in the reduced cost of material handling and manufacturing of parts. Frequently departments may be so grouped as to make certain tools practically common to both, thus obtaining the advantages of practically separate departments, as well as the maximum "use factor" of the tools, the latter, of course, embodying the investment and depreciation charges on tool equipment.

The boiler shop, the most important auxiliary to the erecting shop, requires adequate transportation facilities between it and the latter on account of the tonnage and bulk of this part of the locomotive. This is ordinarily placed at the end of the erecting shop, sometimes separated therefrom by a low wall. This simplifies the overhead crane equipment, usually the pair of 60-ton cranes serving for both shops by means of the continuous runway.

This arrangement has an economic limit, due to the diammetrically opposed extensions for enlarged plant. Also with shops of large size, the tying up of locomotive lifting cranes on boiler work is uneconomical. The boiler shop with relation to the erecting shop in the herringbone type is on practically the same basis as with the longitudinal. Several very succesful methods of handling boilers between erecting and boiler shops have been devised in some of the late and larger plants, laid out with transverse pits. These involve in most cases rehandling but it is questionable as to whether any real additional expense is incurred, due to increased efficiency and speed in the handling of parts with cranes of capacity better suited to the requirements. In some of these the boiler shop is laid out at right angles to the erecting shop, and the provision for future extension of the erecting shop consisting in a doubling up of the erecting shop on the opposite side of the machine shop, in this way approximately causing parallel extension of erecting and boiler shops, and resulting in a very compact and economical grouping.

Quite recently two large repair shops have been constructed

embodying a departure in the transverse type of erecting shop from the former two well established designs, i. e., those with traveling cranes arranged to carry the locomotives overhead in the erecting shop, and those with transfer table service and heavy overhead cranes for lifting only. These plants are provided with a separate bay equipped with traveling cranes for the express purpose of carrying locomotives, thus doing away with the transfer table and also with the carrying of locomotives over the erecting pits. This results in a practical duplication of locomotive lifting cranes with the required superstructure for their runways. While certain possible advantages in wheeling and stripping can be obtained in this arrangement, and undoubtedly a good relation with the boiler shop is obtained, it is possible that these advantages are offset by the additional investment and depreciation charges, due to high initial cost, except for very large plants. In this arrangement the storage space for driving wheels is uneconomical as compared with the more established type of transverse shop, where the wheels are rolled out into a separate and lower bay with much lighter construction and crane equipment.

The handling and storage of driving wheels in the longitudinal type of shop is also not as economical as the above mentioned arrangement. This is corrected to a considerable extent in most of the longitudinal shops by providing for outside wheel storage, which, of course, involves a large amount of handling, using an auxiliary hoist on a crane unsuited in capacity to this work.

On a road of diversified characteristics, resulting in a large variety of locomotives, particularly as to size, the longitudinal type of erecting shop provides maximum flexibility and economy in the use of the floor space, as the transverse type and, to a partial extent, the herringbone type, require equal pit space irrespective of size of locomotive. On the other hand, this is offset to a considerable extent by the inadequate floor space for strippings in the longitudinal type, which is amply provided for with the transverse pits.

Attempted comparison of the operating costs with the different types on the basis of unit floor space of erecting shop results unsatisfactorily, on account of the wide variation in existing plants as to relation of capacity of tributary departments to the erecting shop. This prevents any comparable analysis upon which accurate conclusions could be based. Several plants have been constructed with entirely inadequate machine shop space, which results, of course, from an economical standpoint, in converting the erecting pits into mere storage space; also floor ratios with respect to erecting shop are greatly diversified by physical characteristics of the districts in which various roads are located, such as grades, curvature, water and fuel supply; all of which factors are important in the apportionment of total floor space tributary to the erecting floor.

Without going into details, these comments being intentionally of brief nature, the question of the type of erecting shop may be summed up by stating that it is not of importance equal to a comprehensive economical analysis of the entire repair shop design, which should begin with a careful investigation of all operating conditions in the territory over which locomotives operate, and finally include a scrutiny of the "use factor" of ground, trackage, buildings, general service equipment and tools. Proper consideration is, apparently, not always given this factor, which realizes the balancing of investment, depreciation and tax charges against the direct operating charges, including labor and supervision.

THE HERRINGBONE TYPE.

By Geo. S. Goodwin, Mech. Engr., Rock Island Lines.

Erecting shop layouts may be classified in three general types:

First, Transverse: Having many short pits at right angles to the longitudinal axis of the shop. May be either high or low.

Second, Longitudinal: Having a few long pits parallel with the longitudinal axis of the shop.

Third, Herringbone: Having many short pits at an oblique angle to the longitudinal axis of the shop. Stripping and finishing pits are longitudinal.

The purpose of the following is to discuss the good and bad features of the third or herringbone type and the fact that these are broad general principles which may warrant any of the three shop arrangements to be used will not be

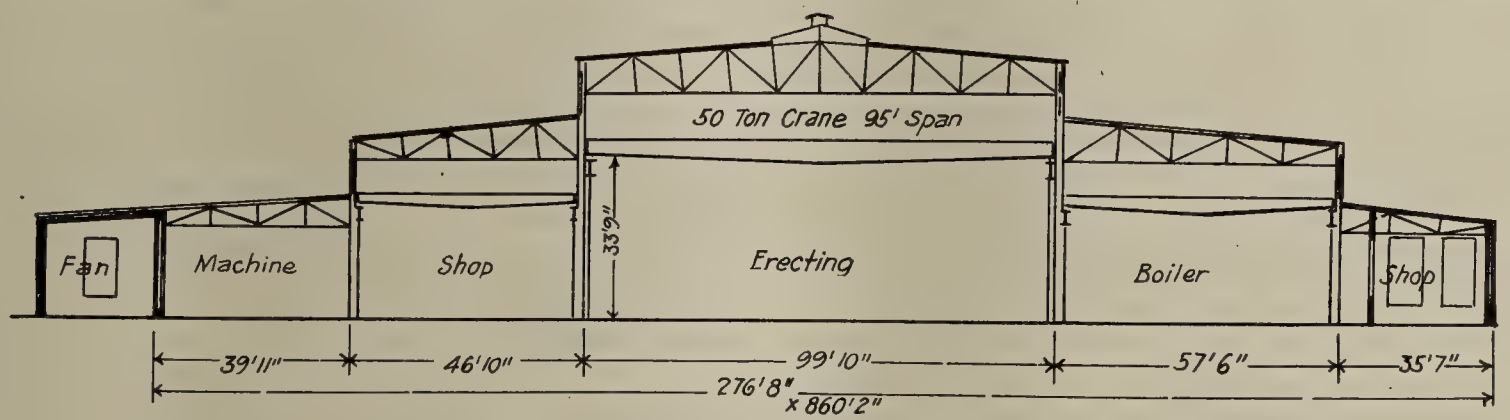


Fig. 1—Elevation of Herringbone Type.

gone into. No doubt, some of the criticisms, both favorable and adverse will also apply to the other designs. These will be based on an experience extending over nine years and with which the writer has been intimately connected for the last three years.

The shop on which this article is based was completed and placed in service in the early part of 1904. The cross section is shown by figure 1, and the general arrangement of the erecting shop by figure 2. To make clear some of the points to be taken up later, it is necessary to describe briefly the movement of an engine through the shop. The engine enters the shop at the east end, stopping on the stripping pits where the running gear and trimmings are removed. From there the stripped engine is transferred to the working pits by overhead traveling cranes, each capable of lifting one end of the engine. The method of procedure is as follows: One crane takes hold of the engine by means of a sling passed under the front of the smoke arch; the other crane takes hold of the engine by a stirrup placed under the tail bar and across the frames. The engine is lifted off the wheels and raised up about 8 feet clear of the floor; moved over the space between the stripping pits; and then carried down the shop to the working pits. During this movement, the two cranes are spaced apart, the distance from front of smoke arch to tail bar. At the working pit the trolley on the crane supporting the back end is traversed toward the wall while the crane supporting the front end is brought forward slowly. This brings the engine into line with the oblique working pit and it is then lowered onto the blocking. The movement from the working pit to the finishing pit is accomplished in the reverse order.

The features of this type of erecting shop layout may be roughly divided into two classes: Structural features and operating features:

Structural.	Operating.
1. Absence of transfer table.	1. Safety.
2. Reduction of height.	2. Speed in handling engines.
3. Necessity of cranes.	3. Accessibility of shop.
4. Capacity of cranes.	4. Flexibility of shop.
5. Length of cranes.	5. Grouping of work.
6. Cost of shop.	

Absence of Transfer Table:

In the herringbone shop, locomotives are handled by suitable cranes, adapted to lift complete engines. A transfer table is therefore not necessary. Its absence, however, cannot be claimed as a distinct advantage for the herringbone type alone, as it is not required in any shop where adequate crane capacity has been provided. A decided advantage becomes apparent when comparison is made with low transverse shops having insufficient head room, when the use of a transfer table cannot be avoided.

Reduction of Height:

In the herringbone shop as one engine is not lifted over another the height can be determined from one or all of the following items:

Clearance for handling cabs and mountings over top of boilers.

Clearance for auxiliary crane service under main cranes.

Necessary height for window lighting.

The shape, arrangement and lighting of the cross section of the shop may affect the height independently of other considerations. For instance, in the shop illustrated, the manner of lighting was responsible for the somewhat greater height of roof. The average height to crane runway required by the above is 25 to 30 feet as compared with 38 to 40 feet when lifting one engine over another:

Necessity of Cranes:

With the herringbone shop it is absolutely necessary to provide overhead cranes. Several years ago this might have been an argument against the arrangement, but this is not true at the present time as all modern shops are provided with crane service.

Capacity of Cranes:

With the herringbone shop two cranes are always used to lift an engine, hence their capacity need only be for one half the weight of the engine.

Heavy lifhts are very few compared with the many lighter lifts, therefore there is an advantage in lighter cranes and more of them.

When single cranes are provided heavy enough to lift an engine, invariably smaller cranes, 10 to 15 tons capacity, are provided at a lower level for the great majority of the work. Hence the large crane is idle the most of the time, or if used in place of the smaller cranes, is found clumsy, slow and requiring excessive movement of tackle.

It must be admitted that even a 50 or 60 ton crane is several times heavier than required for probably 90% of the lifts, but when provided with an auxiliary hoist compares more favorably with the light crane for light work. There is also an element of danger from operating one crane above another, due to possible interference of cable.

Length of Crane:

The herringbone shop requires very long cranes in the double erecting shop style illustrated. While this is a disadvantage in itself there are advantages which help offset it.

It is universally conceded that a shorter stop is more economical than a longer one and this is illustrated by a number of large shops where, to get the required capacity, two erecting bays are provided. With the herringbone shop the two are combined, thus reducing crane runway construction by one half, to say nothing of its greater compactness.

The ability to build a double erecting shop under one crane span is an advantage confined entirely to the herringbone shop, as it would be out of the question to build single cranes of capacity enough to handle modern locomotives, and having a span of at least 100 feet. It may be possible to lift an engine in a transverse shop with two double trolley cranes, one on each side, but it certainly would not be entirely safe and open to far greater criticism than lifting an engine with two single trolley cranes one at each end, as in the shop illustrated.

Cost of Shop:

It was stated in 1907 before the New England Ry. Club, by Mr. G. R. Henderson that a transverse shop would probably average 25c more per square foot than a longitudinal shop. It may be observed that the herringbone shop allows lighter capacity cranes and lighter runways over the transverse shop, and the same capacities as required by the longitudinal shop with probably a slightly lighter runway construction. The roof construction would probably be much heavier than either of the other shops. Mr. Henderson's figures may or may not have included cranes, but certainly included crane runways.

The writer does not have at hand any definite figures on costs of the different styles of shops, and as these figures are dependent on so many variables a comparison of existing shops might not give a proper measure. It would be an engineering department problem to assume shops of the different style and estimate the approximate cost.

Safety:

In the handling of any material there is a certain amount of danger to employees and one of the first considerations in the operation of a shop is to guard against accidents. In the herringbone shop the locomotive is raised only about 8 feet off the floor and the entire movement is made at this height. The movement is made in the center aisle of the shop where there is no work going on. The men are working on the sides of the engine or on the benches between the pits and the only men in the aisles are those going from point to point in the shop and who can readily step out of the way of a locomotive or material movement as it passes.

This is not true either of a transverse or longitudinal shop. In a longitudinal shop the men are mostly working on the side of the engine and in the path of the moving material.

Speed in Handling Engines:

Since it is not necessary to lift one locomotive over another, i.e., an 8 ft. lift versus a 20 ft. lift, it naturally follows that it takes less time to handle the engines. In this type of shop, the movement is also made with a minimum loss of time by workmen, as the majority are employed on either side of the path of movement. If the engine is carried overhead it passes over practically all the men on the floor, taking the attention of nearly every individual during its progress over them.

In connection with the speed of handling engines, the amount of power required should also be considered. It usually occurs that locomotives must be lifted without regard to load conditions throughout the entire plant, with the result that a sharp peak is frequently imposed on the power plant machinery at such times. Engines and generator capacity must of course, be provided sufficient to take care of this condition which is ordinarily accomplished by the installation of generating equipment having an adequate overload rating. The amount of overload capacity required depends largely upon the duration of peak load. It follows that if the time required to lift a locomotive is reduced, smaller and less expensive electric generating apparatus may be used without danger of breakdown.

This point becomes of extreme importance when as is frequently the case, a part of the power plant's overload capacity is already consumed in taking care of the normal shop load.

Accessibility of Shop:

The arrangement of type 3 gives easy access to all parts of the shop for trucking and movement of men, there being no pits to cross. The center aisle makes an ideal passageway for the movement of material and with the minimum sacrifice of space, since it serves both sides of the erecting shop. The boilers are always handy for removing and applying flues and do not need to be moved on this account. The average span of cranes in the transverse shop is 65 to 70 feet and the

distance between pits is about 22 feet. One engine stands in this space while in figure 2, the space for two engines is 95 x 22 or for one engine 47 feet 6 inches x 22 feet. In a longitudinal shop the engines must be spaced far enough apart so that flues can be removed and applied. While not all the space under the 65 or 70 foot crane is always utilized as a working pit, and while the latest large engines require longer and perhaps wider pits in the herringbone shop, there is still a good deal in its form as regards compactness.

Flexibility of Shop:

The argument is advanced that the longitudinal shop is more flexible than transverse, but less compact. Type 3 has the flexibility in the stripping and finishing pits where most desired, and compactness in the working pits which are proportioned for the average large engine. These are numerically far in excess of the abnormally large engines. To provide for the abnormally large engines why not extend the finishing pits in figure 2 sufficiently to provide a longitudinal shop for such engines.

Grouping of Work:

With the herringbone shop the stripping is taken care of at one end of the shop and here are located driving wheel lathes, driving box work, etc. As these parts are repaired they are stored at the opposite end of the shop, adjacent to the finishing pits thus cutting out all useless movements of material. The arrangement of the finishing pits with their greater clearance, further takes from the working pits the parts which are applied after the engine is wheeled and which would interfere with the work in other engines on the working pits.

The points discussed as regards herringbone locomotive repair shops might be summarized briefly as follows:

Absence of Transfer Table can hardly be claimed an advantage over the other two shop arrangements except in the case of low transverse shops.

Reduction of Height, is an advantage over the high transverse shops.

Necessity of Cranes, is present in all modern shops.

Capacity of Cranes, considering the number required, there probably is an advantage over the high transverse shop.

Length of Cranes is a disadvantage over the other two shops.

Cost of Shop. This probably would be less as compared with a high transverse shop. A careful estimate would have to be made as compared with a long shop.

Safety, is an advantage over the other two shop arrangements.

Speed in handling engines is an advantage over the transverse shop owing to the low lift. At the same time the duration of a possible overload on the power generating facilities is reduced to a minimum.

Accessibility of Shop is an advantage over the longitudinal shop. Having the erecting shop all together is an advantage over the transverse shop both on account of accessibility as well as greater compactness.

Grouping of Work is an advantage in that it gives the minimum movement of material.

Flexibility of Shop is an advantage over the transverse shop.

The writer desires to acknowledge the help received from the superintendent of shops, general foreman and others in preparing this article. The views expressed are based on the shop in question and may not agree with the experience of others with the other type of shops. So far as is known the only other example of herringbone shop is at Moncton, Canada, on the Inter-Colonial Ry.

ERECTING SHOP TYPES.

By W. R. McKeen, Consulting Engineer, U. P. R. R.

In my opinion, the most economical erecting shop shape is the round one with an overhead electric traveling crane for the circular transfer of material and a supplementary trackage service to a central power turntable, distributing the material from the erecting shop to the other associate shops by electric or gasoline power trucks, thus affording a complete system of handling the material by the most up-to-date labor-saving devices, and permitting of the most economical and efficient location as well as organization of the blacksmith, boiler, machine and other shops, avoiding thereby the necessity of their being absolutely mapped out in conjunction with the erecting shop. The ordinary railroad erecting shop does not lend itself to economical operation if designed and located in combination with machine shops, nor is the convenient location of erecting tracks possible; furthermore, it is not susceptible of economic expansion in conjunction with its associate shops. This observation also applies to the boiler as well as the blacksmith shop.

Any plant which necessitates the close proximity and association of all these different shops precludes, as a rule, the economical and advantageous extensions or further development in the capacity of same. I believe, equipped with necessary machinery, there can be just as economical and advantageous results obtained from a longitudinal shop as there can from a transverse erecting shop. The controlling factor in selecting either a transverse or longitudinal erecting shop is, primarily, the one of space; secondarily, however, is the organization of the shop. If the work is to be done by the old-time system of gang boss supervision, which dismantles as well as rebuilds the locomotive complete, the transverse shop affords less loss under such conditions than the longitudinal. On the other hand, where the shop is organized on an economical and efficient basis, where the work is divided up and specialized with special gangs han-

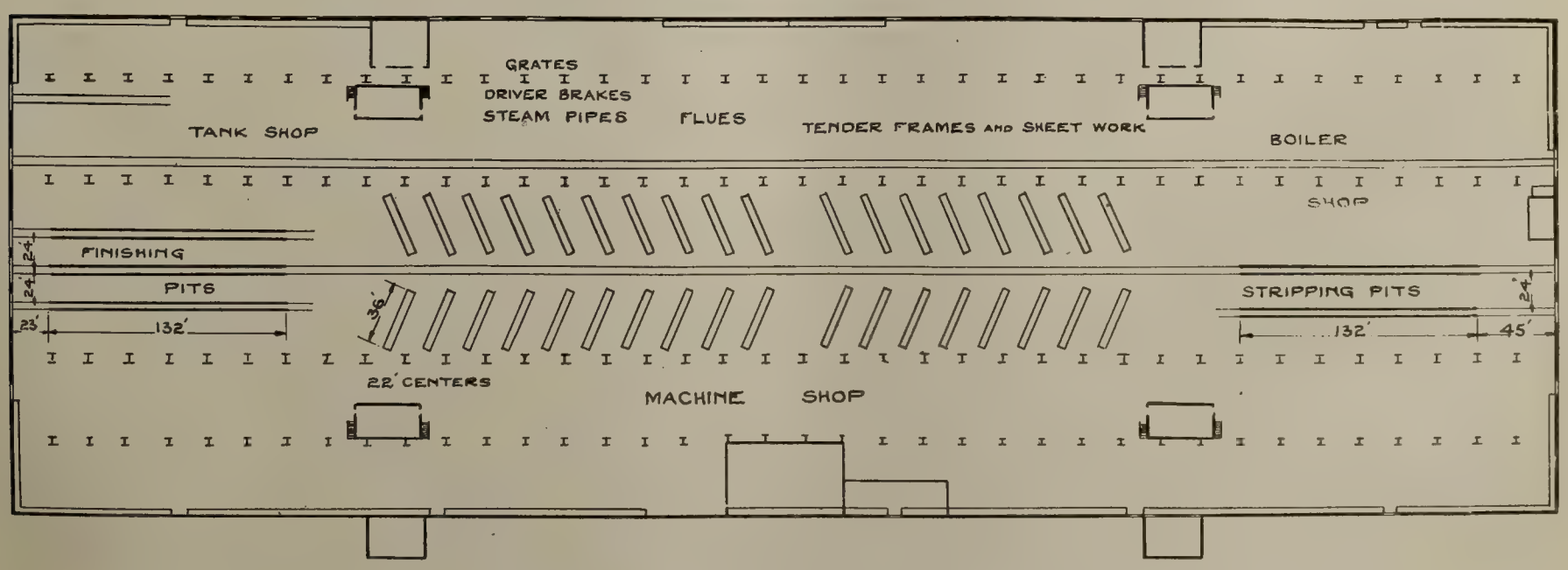


Fig. 2—Plan of Herringbone Type of Shop Building.

dling the wheels and axles, special gangs for the front end, special gangs for guides, etc., and the whole shop is mapped out on a unit labor-saving efficiency basis, the longitudinal shop is more conducive to economical and harmonious results. This is true notwithstanding the fact that the transverse shop can be organized on an efficient, economical basis, in my opinion, equal to the longitudinal, except that it takes closer study and a much higher and more efficient organization in order to get the same results.

Where the crane service is limited and the handling of heavy material must be performed largely by hand or jib cranes or standard track facilities, the transverse shop is unquestionably more easily handled. The longitudinal shop excludes any idea of handling material by gang labor and necessitates large capacity cranes not only of high power but capable of efficient and quick service, and the whole area of the longitudinal shop is covered and efficiently served by these cranes; thus the labor of handling is almost by necessity reduced to a minimum.

Where the machine work in a repair shop is still handled on an individual repair basis—in other words, where the individual pieces from the locomotive are taken to the machine shop, refitted or re-machined, or in any way repaired, and returned to the individual locomotive—a close proximity of the machines is necessitated and is in favor of transverse tracks. On the other hand, the grouping of repair parts into numbers and putting them in the machine shop in wholesale lots instead of as individual units, making the repairs to locomotive parts somewhat similar to the economy obtained in an ordinary manufacturing plant, is all in favor of the longitudinal shop, which again practically necessitates this kind of efficient and economic organization.

Thus, where an erecting shop with the locomotives distributed to their respective erecting tracks, via a high-power turntable, and the work to and from the blacksmith, boiler and machine shops can be transferred in the same quick, expeditious and short-route method with power trucks via the turntable to those respective shops, located advantageously and economically, consistent with their own requirements, it is made possible to organize each shop on its own efficient and economic basis, and the efficiency of one shop is not interdependent on the standard of its associates, nor is its expansion nor its facilities limited in any way by its associate shops.

The kind of shop is, after all, therefore, a question of economic organization more than it is of shape; the highest possible economy, however, is a question of policy and somewhat a question of investment. In my opinion, no railroad shop should be built without the possibility of expansion, as the history of the past shows the enormous sums of money lost by the impossibility of economic expansion of railroad shops.

A COMPARISON OF TYPES.

(By a Superintendent of Motive Power.)

The longitudinal shop with pits on an angle can handle more engines in the same floor space than can a straight longitudinal shop, but the disadvantages to this are that when you have a quantity of small power, there is no advantage in the longitudinal shop with pits on an angle, as you can only set one locomotive on a pit, while with a straight longitudinal shop the smaller size of locomotives justifies the housing of more engines undergoing repairs.

The longitudinal shop I consider one of the best from an output standpoint, for the reason that it can be handled with less supervision, and, with machines properly arranged, there should be economy in the cost of repairs per locomotive, in addition to increased output. It is also my belief that the cranes, both large and small, work to a better advantage in the longitudinal than in other types of shops, on account of their ability to handle more work with fewer movements of the crane up and down the shop. I do not, however, believe it is possible to keep a longitudinal shop in as clean or presentable appearance as a transverse pit shop. Otherwise, there are but few objections to the longitudinal type shop as compared with the advantages it has.

The transverse shop, while it is considered to have many advantages, has an arrangement which is objectionable to the workmen, on account of the inconvenience due to the distance the men have to walk in handling their work, and especially so for the foremen and supervisors, who find it more difficult to supervise their work on account of the same number of locomotives covering a greater floor space than is found in the longitudinal shops.

The feature of stripping locomotives does not show much advantage one shop over the other, but it is noticed that the assembling of material is considered by the men and foremen to favor a longitudinal shop as against other types which I have mentioned or may at this time be considered modern locomotive shops.

TRANSVERSE VS. LONGITUDINAL SHOPS.

By J. F. Enright, S. M. P., Denver & Rio Grande R. R.

The transverse and longitudinal shops will both, in my judgment, serve the purpose of railway requirements for many years. With the extremely heavy power of today, the shop designer should be able to very readily determine which design would best suit.

The Denver & Rio Grande R. R. has recently added sixteen very heavy Mallet type engines to its equipment, bringing the total number of this type of engine up to twenty-four, and, because of this, and the other heavy power on the Utah Lines, we have recommended a longitudinal shop with two crane units for our Salt Lake City shops, and for the east end of the line, where the power will never be as heavy as on the west end, we have recommended a transverse design.

ELIMINATION OF THE TRANSFER TABLE.

By V. C. Caracristi, Consulting Engineer, Delaware & Hudson Co.

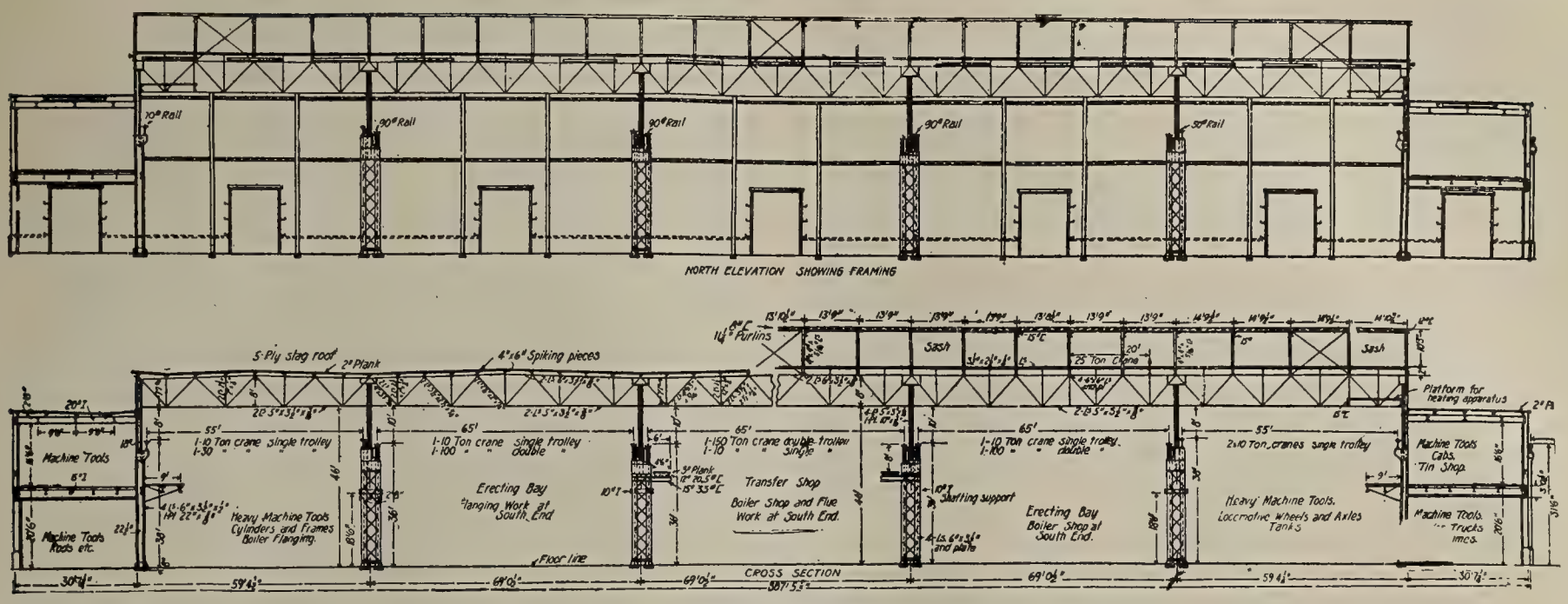
Two shops of the same original and interesting design are those of the Wheeling & Lake Erie at Brewster, Ohio, and of the Delaware & Hudson Co. at Watervliet, N. Y. (The general layout and a section of the erecting shop of the Watervliet installation, which was fully described in the Railway Master Mechanic for October, 1912, are reproduced herewith.—Ed.)

The primary object in adopting this design of erecting shop at both plants was to permit the concentration of the maximum amount of work under one roof, and to place the machine tools as closely as possible to the erecting floor, reducing to a minimum the movement of the detail parts of the locomotive requiring machine repairs from the erecting floors to the machines and return.

At Watervliet the driving wheel work is all done in the transfer bay, reducing to a minimum the manual handling of the driving wheels, the entire work being done by cranes without any cross movement. This bay is also extended, as in the Brewster shop of the Wheeling & Lake Erie, to a length sufficient for the boiler work, doing away with the awkward cross handling between bays or shops of the boilers where the necessity for heavy repairs on them exists; also permitting the flues to be handled entirely by cranes from the engine on erecting floor to the cleaning and safe ending department and return.

This design of shop was gotten out simply to eliminate the necessity of a transfer table and to make it possible to somewhat reduce the width of the erecting shop by utilizing space of the transfer bay for the removal of flues and the storage of driving wheels, cabs, etc.

The first cost of a shop of this character, in which the transfer crane is under roof, is somewhat greater than the transfer table shop (eliminating the value of the ground). The entire space, however, which is under roof is valuable for repair work. Not only does the substitution of the crane for the table permit free communication between the various departments, but it also gives additional space for erecting floor work; does away with the necessity for storing stripped locomotive material out


NORTH ELEVATION SHOWING FRAMING
CROSS SECTION
Machine Tools
Heavy Machine Tools Cylinders and Frames Boiler Flanging.
Erecting Bay Flanging Work at South End
Transfer Shop Boiler Shop and Flue Work at South End.
Erecting Bay Boiler Shop at South End.
Heavy Machine Tools. Locomotive Wheels and Axles Tanks
Machine Tools Cabs. Tin Shop.
Floor line

Section of Watervliet Machine and Erecting Shop, D. & H. Co.

in the yard or away from the shop. The results at Brewster have been so gratifying that I feel certain a good many shops of this kind will be used.

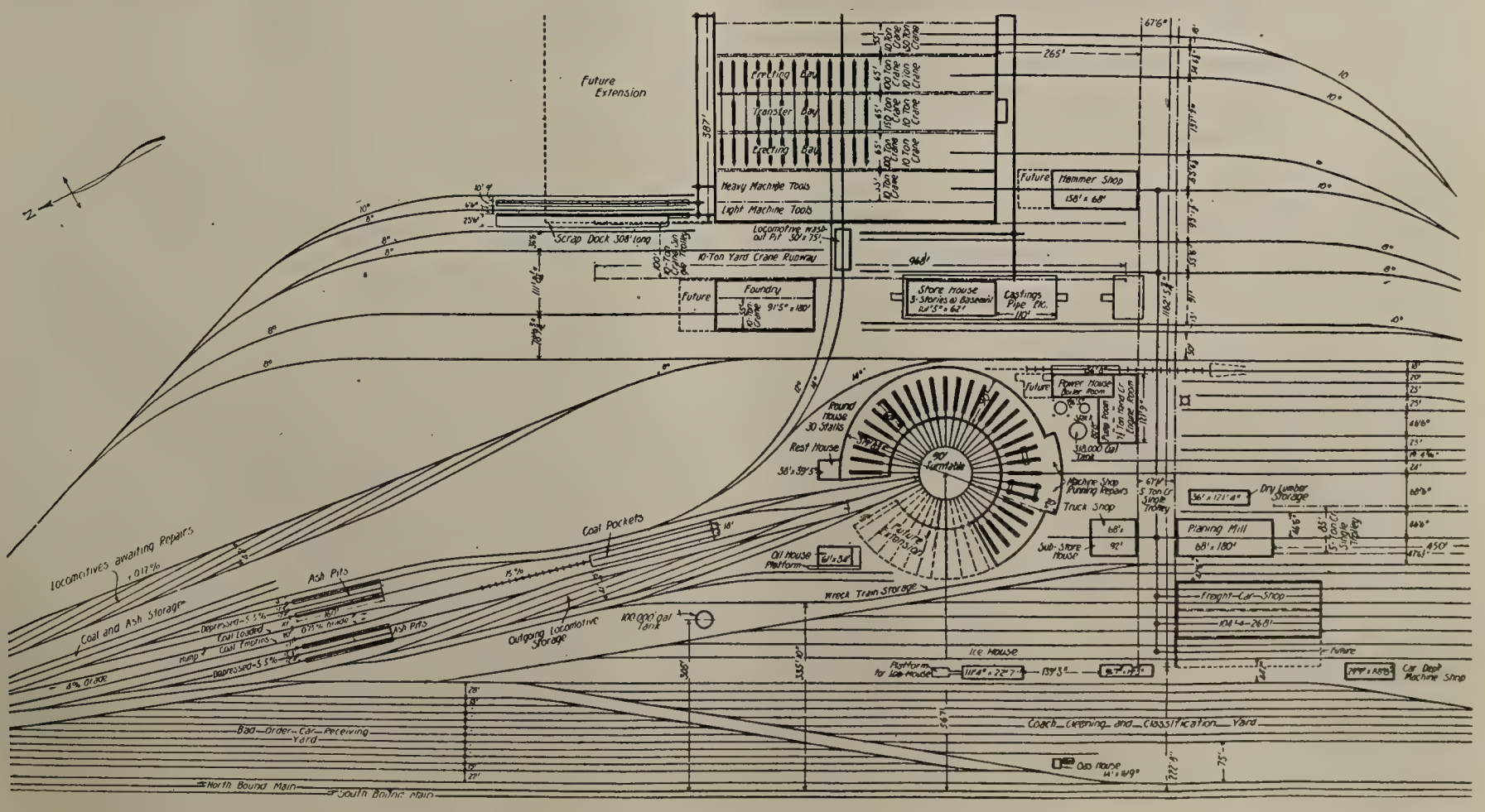
In making a shop as wide as the Brewster or Watervliet shops, the structural difficulty of sufficient light occurred. This made it necessary to put in cross skylights, which, in order to eliminate expense for repairs and to facilitate their cleaing, were made vertical, placed on top of the roof truss so as to permit the carrying of wires, heating ducts, etc., between the members of the roof truss proper, and also in order to give head room in which to place the heating units.

In both of these shops, all piping, wiring, heating ducts, etc., were placed above the floor line. Had the space not been provided for the carrying of the heating units in the roof of the Watervliet shops, it would have required additional buildings of approximately 3,000 sq. ft. floor space, and several thousand feet of floor space would have been taken away from legitimate shop purposes by the entrance of the heating ducts through the floor into the buildings, and the cost of heating would have been materially greater.

RELATIVE MERITS OF THE LONGITUDINAL AND TRANSVERSE TYPES.

By Roger C. Barnard, Asst. to V. P. Westinghouse, Church, Kerr & Co.

The relative merits of the longitudinal and transverse types of locomotive erecting and machine shop have aroused almost as much discussion in recent years as has the question of the various types of steam road trunk lin electrification. In much the same way as the electrification problem is clearing up and it is becoming daily more evident that the margin of difference is narrower than supposed and that the precise type of design, construction and equipment depend almost entirely on the peculiar conditions surrounding each problem, so also it is becoming more apparent that the margin of construction and operating difference between the longitudinal and the transverse types of erecting shop is at best a narow one with favorable and unfavorable features to each type. Some of the advocates of the longitudinal type, for instance, claim greater flexibility of operation while the advocates of the transverse type point to its easier lighting, neater appearance, etc.



Layout of Watervliet Shops, Delaware & Hudson Co.

The net result of the argument seems to be that other things being equal either type of shop can be economically designed, built and operated with little, if anything, between them when considered in the large.

The fundamental conditions which determine the exact type of shop for any given location include ordinarily the size, shape and topography of available land, location with reference to existing buildings, existing track and yard layout, the probable future extension of the shop and the question how far any or all of these features limit the ultimate design of the new structure. Careful study of these underlying conditions usually indicates rather clearly the type of shop which will best meet them and the question as to which of the two types or what modification of them shall be adopted resolves itself quite largely into the personal preference of the engineering and mechanical departments of the railway itself.

As illustrating the situation, we would point to two recent examples of modern erecting shop layout, designed and built by Westinghouse, Church, Kerr & Co., under the direction of the engineering and motive power departments of its clients.

1. Illustrates a longitudinal layout constructed for the Chicago, Burlington & Quincy Railroad at Havelock, Neb., with a nominal capacity of 35 to 45 locomotives undergoing repair at one time, this number depending on the size of locomotives.

2. Illustrates a transverse layout constructed for the Canadian Pacific Railway at Calgary, Canada, with 35 pits.

In the case of the Havelock layout the new work had to be designed to fit in with an existing layout, the shop lying between the storehouse on one side and the blacksmith shop on the other. Further extension longitudinally of all three buildings can be easily effected and the yard crane runway extending across the end of all three structures permits the ready transfer of materials. When the future extensions are made another crane will be put in across the other end of the buildings. Following modern practice the heavy and light machine tool bays are parallel to and open directly out of the erecting shop. The general lighting arrangements will be evident from the illustration and comprise in general a large monitor in the center of the erecting bay with ample side light the entire length of the upper walls. The machine bays are lighted from the side, it not being found necessary to run a monitor down these bays. Details of construction and equipment including traveling cranes are plainly shown in the illustration, the shop being naturally somewhat lower than the lift-over type of transverse shop, since the locomotive can be carried down the shop between the aisles. The machine bays are crane served so that material can be handled as readily from the erecting floor as would be the case in a transverse shop.

In the Calgary layout an entirely new shop was designed and built and it should be noted that no provision is made for extension of any of the departments except the passenger car department. On account of the topography of the land, entrance could not be obtained to the property from both ends but a track arrangement was worked out so that the single ended entrance does not limit the movement of equipment in any way. In this shop all of the departments are located under one roof, including not only the erecting and machine but also the boiler and blacksmith shops. It is believed that this feature of design when conditions warrant will come into more general use.

Its chief advantages are primarily the facilitating of transportation of materials and saving of lost motion as well as re-

Fig. 1—C. B. & Q. Shop at Havelock, Neb.

Fig. 2—C. P. Shop at Calgary, Alta.

ducing the cost of construction. It is sometimes claimed on the other hand that the noise incident to the operation of the boiler shop and the gas and smoke incident to the operation of the blacksmith shop might be a disadvantage in this arrangement, also that it is more difficult to heat a large shop and that the fire risk is greater in this arrangement. The apparent advantages as enumerated above so clearly outweigh the apparent disadvantage that until there is further weight of evidence, it seems clear that the arrangement is a favorable one and that the practice will continue to spread. Most of the disadvantages can be entirely obviated by building light curtain walls between these departments in the main shop, if this later should seem necessary.

The use of a long yard crane running between the end of the locomotive shop and the storehouse permits a very quick and economical handling of material. The lighting arrangements will be apparent from the illustration; the main erecting bay receives side light in both directions over the roofs of the adjoining bays housing the machine and blacksmith shop, the heavy machine bay in turn receiving side light from a line of windows running its entire length while the light machine bay is partly lighted by side windows and partly by sawtooth roof.

A somewhat similar arrangement prevails in the blacksmith and boiler shop bays except that monitors are used on account of the great accumulation of smoke and gas in these departments.

So far as the general design of the erecting shop is concerned the present practice, particularly in the larger shops, has become fairly well standardized although it is true that the conditions in any particular locality determine many of the details of both construction and equipment.

In general, the modern shop comprises a steel frame with clear room from floor to roof trusses spanned by one or more electric traveling cranes. Parallel to this shop and opening directly out of it lie the heavy and light machine tool bays and as previously noted the blacksmith and boiler shops are now often-times combined within the same structure. The structural materials of the building, outside of the steel frame are many and in general comprise concrete for all footings and foundations, brick, cement plaster on metal lath and concrete for side walls and concrete, wood, tar and gravel, or composition roofing. Floors are generally of concrete, wood block or asphalt. Piping, wiring, water supply and other service systems usually run into the shop under ground from a central power plant, sometimes in a special concrete service tunnel, if there are sufficient facilities to justify this expense. The arrangement of machine tool layout is capable of infinite variation, practically all tools in a modern shop being motor driven either through group or individual drive.

Two interesting variations in the usual practice of overhead cranes may be cited. One is the case of the shop at Spirit Lake, Idaho, for the Idaho & Washington Northern Railroad. This shop takes care of a small number of engines and heavy crane equipment was not justified. In place of cranes, drop pits with strong hydraulic pit jacks were installed with which it is possible to remove and replace wheels without recourse to jacking up. A ten-ton overhead crane completes this equipment. The other instance of compromising present and future needs is shown at the Wichita, Kas., shops of the Kansas City, Mexico & Orient Railroad. In this case an erecting shop was built and a transfer table is planned as part of the ultimate equipment. At present it is omitted and its function is fulfilled by having the erecting pits directly connected to the outside tracks in the yard. Ultimately a transfer table will be installed which will serve the erecting shop and the boiler and coach shop which lie directly opposite.

CAR VENTILATION.

By William J. Fleming, Jr.

Of the Automatic Ventilator Company, New York.

Two factors have contributed to the present demand for better ventilation in passenger cars: First, a greater and more widely diffused knowledge of the value of pure air, both as a curative and preventive of pulmonary diseases; and, second, more air-tight car construction.

The problem, briefly stated, is to provide fresh air for fifty to seventy persons, imprisoned in a practically air-tight box having a capacity, after deducting displacement of seats, passengers, etc., of 4,000 to 5,000 cubic feet.

Opinions differ as to the volume of air necessary for good ventilation, some authorities claiming that 3,000 cubic feet of fresh air per person per hour is imperative; other equally eminent

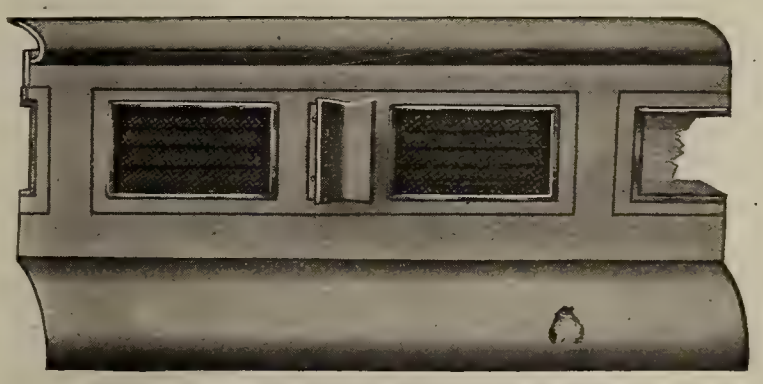


Figure 1.

authorities advocate 1,000 cubic feet, while still others base their recommendations on a change of the car air ten to twenty times per hour, irrespective of the number of passengers. This latter method or basis would seem to be the simpler, in that the ventilating system would not require frequent readjustment to meet varying car loads.

Inasmuch as the average passenger is more interested in the *temperature* of the car in zero weather than in the purity of its atmosphere—deeming death by asphyxiation pleasanter than by freezing—it is quite essential that the required volume of fresh air shall be furnished without perceptible draught and without reducing the car temperature below, say, 60 degrees Fahrenheit.

Would it not be safe to say that a complete change of the car air every six to eight minutes would, in cold weather, constitute reasonably good ventilation? As a matter of fact, very few public or private buildings approach this degree of perfection. In mild or warm weather, when the outside temperature does not vary greatly from the inside, a change of car air every minute or two may be quite desirable; in fact, the passengers usually take care of this by opening the windows and, incidentally filling the car and themselves with dirt and cinders.

The present methods of accomplishing the above results are as follows:

The Deck Sash.

This device is too well known to require description. The deck sash, as a ventilating medium, is erratic, sometimes acting as an ''intake,'' sometimes as an ''exhaust,'' and on still other occasions remaining neutral. In cold weather, when most needed, they set up excessive draughts and are practically useless. It is a continual source of friction between passengers and trainmen; occasionally provides grounds for a lawsuit and occupies a neat little column in the car maintenance ledger.

The cost of applying deck sashes, with their accompanying ratchets, screen sashes, screening, etc., has been placed by different car builders at from $40 to $80 per car, so that this form of ventilation has not even the excuse of *cheapness* to warrant its continuance.

The ''Exhaust'' Ventilator.

Exhaust ventilators are legion in type, but one in principle. A current of air, caused by the motion of the car, is directed past an opening leading into the clerestory. The partial vacuum set up at the outside of the opening induces an exhaust of the car air. The Master Car Builders' Committee report, presented at the 1908 M. C. B. convention, made the following comment on exhaust ventilation:

''The fact that no special intakes are provided to supply the large amount of air that should be furnished for good ventilation, makes it necessary that this quantity of air must be drawn either from the ends of the cars or in through the cracks around the windows, or drawn down the lamp jacks. The admission of any such quantity of air as 60,000 cubic feet per hour through cracks around the windows and doors would, if it could be accomplished, create intolerable draughts and would make the occupation of a seat next to the window very undesirable in cold weather. These strong exhaust ventilators will always set up excessive draughts, even if very much less air is being drawn through the car than is required for good ventilation and the result necessarily will be an excessively draughty car.''

In view of the foregoing, it is interesting to contemplate the recent claims of tests showing an exhaust of 140,000 cubic feet per hour in a 2,600 cu. ft. compartment, and one of 100,000 cubic feet in a 600 cu. ft. compartment, a change of air 53 and 166 times per hour, respectively—presumably through cracks and crevices. If these tests were made during cold weather, a table showing car temperatures and cost of heating would be very interesting.

Some of the ''exhaust'' systems arrange for the admission of fresh air by means of several swing deck sash, usually four, one at each corner of the car, thus replacing the window draughts by those of the well known deck sash variety.

''Intake and Exhaust'' Ventilators.

The Pennsylvania or ''Dudley'' System.

An M. C. B. committee report describes this system as follows:

''This system admits the air through hoods, located on diagonal corners of the car. The air passes down a vertical boxing

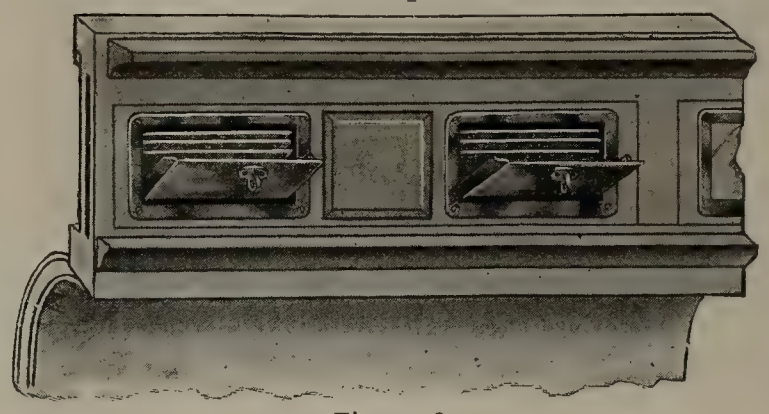


Figure 2.

to a horizontal duct under the floor, which duct runs the length of the car between the sides and the adjacent intermediate sills. Then the air ascends through slots in the floor to a longitudinal boxing or duct containing steam pipes, extending along the sides of the car, above the floor and immediately over the air duct, thence through galvanized iron tubular pipes under each seat to the aisle, where it ascends and passes out through globe ventilators located over the lamps along the center line of the upper deck.''

This system, while possessing some minor faults, is unquestionably very efficient. The fact that this system has not been adopted by railways other than the Pennsylvania (although Dr. Dudley, its inventor, took out no patents thereon, but generously offered his ideas gratis to all), is due, no doubt, to the excessive cost of installation and the additional expense of heating the car by this method.

The fact remains, however, that Dr. Dudley was the first to recognize the fact that a *positive ''intake,'' under absolute control,* was the feature of *first* importance in a ventilating system; that the ''exhaust'' was a secondary consideration.

The ''Automatic'' System.

This device consists of an exterior deflector, two interior diffusion boxes and two air ducts, the combination of these parts constituting a ''set.'' A set occupies one deck sash opening, as shown on Figs. 1 and 2.

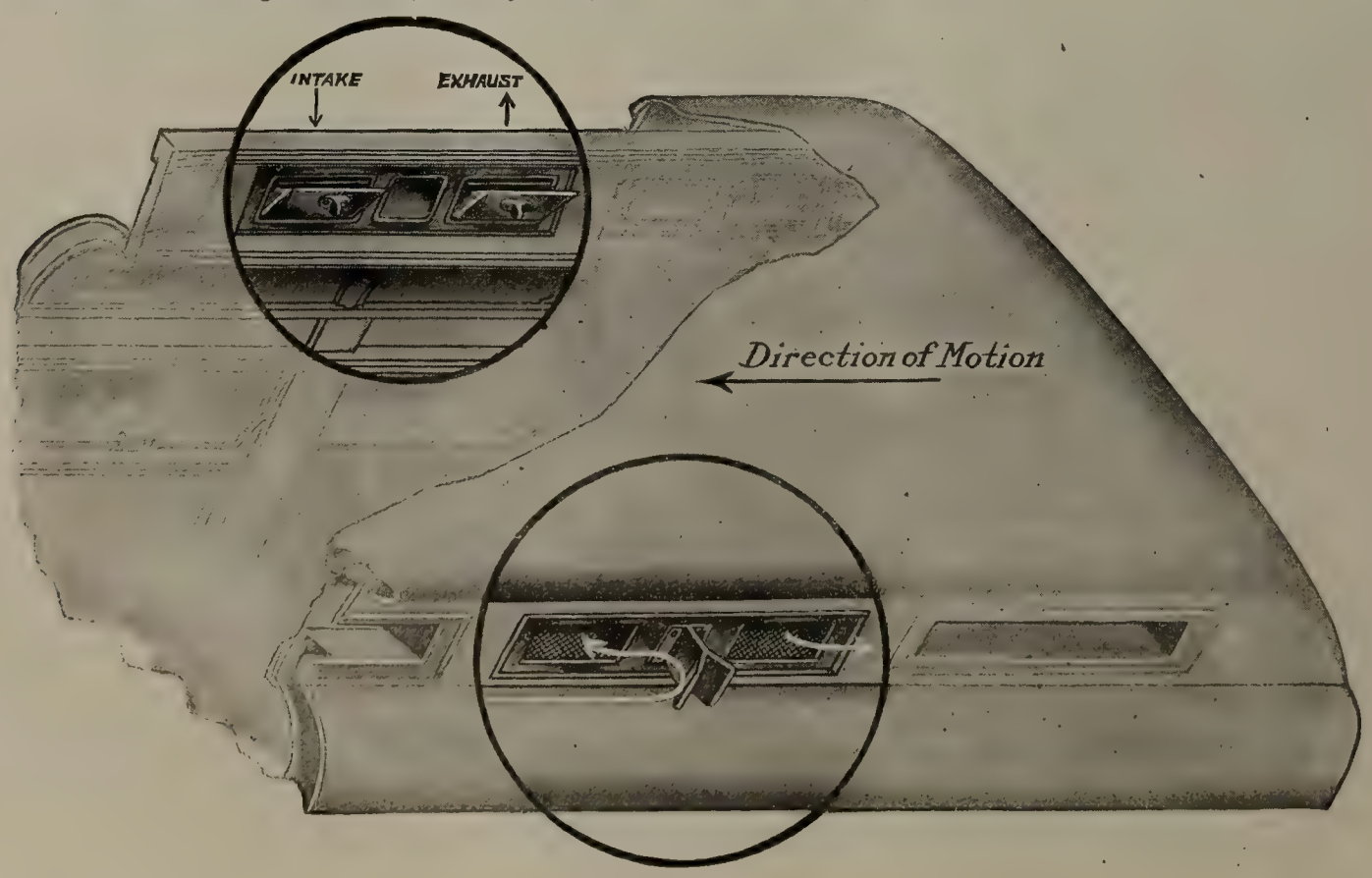


Figure 3.

When the car is in motion, air impinges against the exterior deflector and is "caromed" into the forward port of the set. Passing through the interior diffusion box, which is provided with a series of horizontal louvres, this air current is directed upward toward the ceiling of the car, thus preventing a downward draught. After losing its initial force, the incoming fresh air, being heavier than the impure car air, descends to the breathing and floor levels, and is warmed and diffused in its descent.

A partial vacuum is set up at the rear of the exterior deflector which, assisted by the pressure of the incoming air, induces a strong "exhaust" of the rising vitiated air, at the rear port of the set. (See Fig. 3, arrows indicating direction of air currents.)

These two currents—"intake" and "exhaust"—are evenly balanced and maintain a complete circulation of the car air at all times, and largely eliminate the draughts through windows, deck sash, toilet plumbing, etc., that are unavoidable with exhaust ventilators.

Where the "automatic" is applied all deck sash are made stationary and screen sash omitted, effecting a saving in first cost, as well as in maintenance. For a standard coach, from 8 to 12 "sets" are required, depending on size of ventilator and capacity and service of car.

Hundreds of anemometer and thermometer tests, made in cold weather, under actual service conditions, have shown that the automatic ventilators introduce, under varying car speeds, from 100 to 250 cubic feet of fresh air per minute. Ten sets, on this basis, would be changing the car air 12 to 30 times per hour. In zero weather a change of the car air in 2 minutes might prove too much for the heating apparatus, in which case the supply may be regulated by closing the diffusion box shutters on some of the "sets" or, better still, by partially closing the shutters on all sets.

This system is at present in operation on thousands of steam and electric passenger cars throughout the United States and Canada.

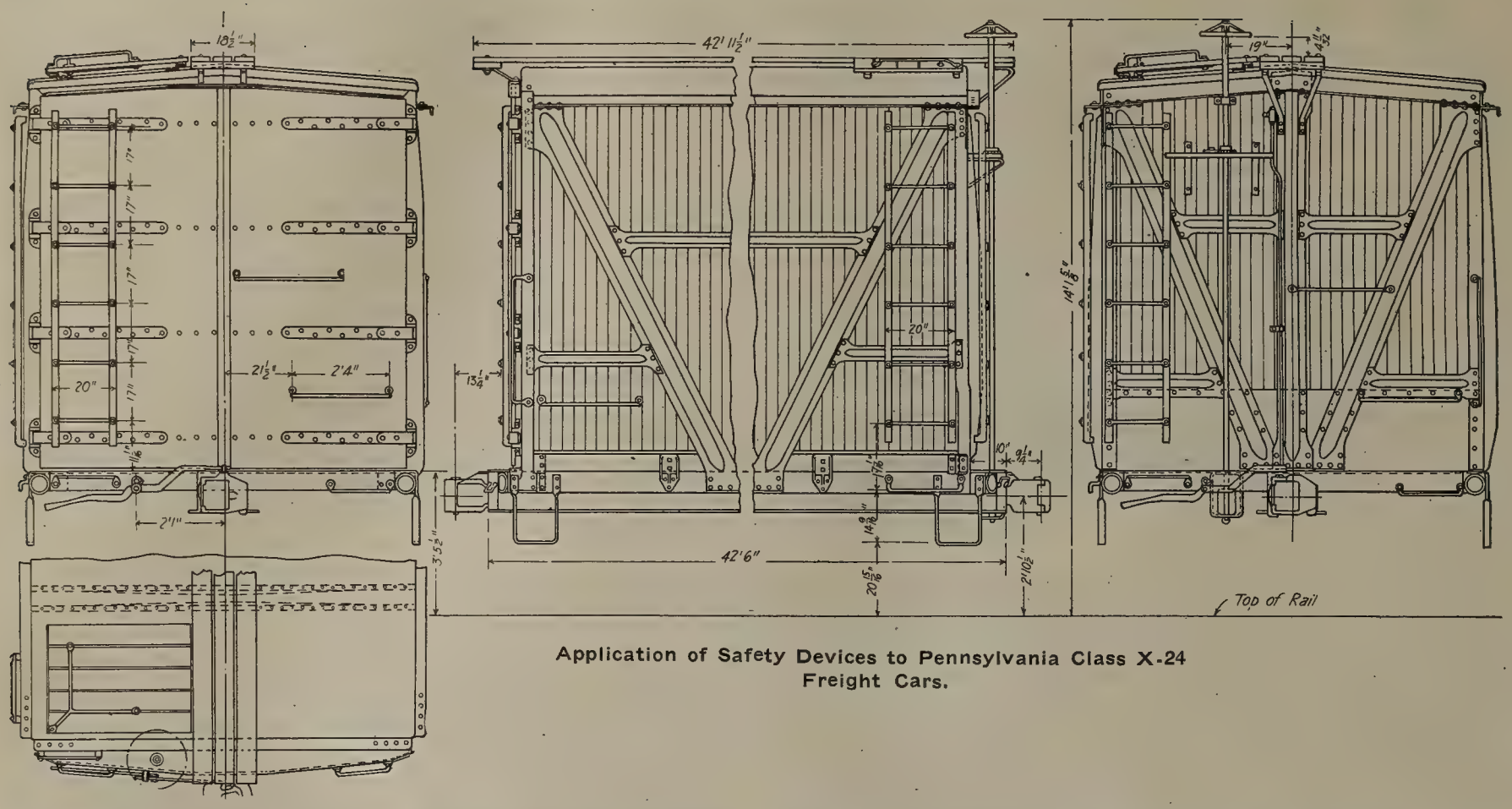
Standard Box Car Construction.

The total number of cars belonging to roads which are members of the American Railway Association, on January 1, 1912, was 1,064,925. These cars are rolling all over the country and undergoing all sorts of usage and climatic conditions. The steady growth in traffic with its attendant growth in the size of motive power and rolling stock, is placing great strains on these cars and there has been much agitation resulting from the great number of cars which are standing on the repair tracks.

The box car, or any other piece of equipment for that matter, must be kept in service as continuously as possible if it is to give the highest return on the investment. It has been very aptly designated as "legal tender equipment," and such it truly is. It is the common medium of exchange and, as with money, should be regarded as the property of the road whose lines it is on. The growth of interchange has resulted in a growth of standardization, and these standards have increased so rapidly that the time will soon come when the car as a whole may be standardized. The first restricting factor which resulted from universal interchange was the line clearances of the roads, such as tunnels, bridges, etc. This made certain limits with regard to dimensions absolutely necessary. The operation of cars in interchange then necessitated certain standards with regard to couplers and air brakes. These were adopted by the Master Car Builders' Association in the late eighties and early nineties. Following this came standards with regard to journal boxes, wheel treads and flanges, brake heads and beams, steam and air connections, arch bars and columns, dust guards and axles. Then came the safety appliance acts which necessitated standards with regard to hand brakes, ladders, running boards and hand holds. Other details with regard to lettering, flooring, siding and side doors have also been adopted as standard, but by far the greatest amount of standardization has been below the underframe. Cars should be kept rolling and should be repaired in the shortest possible time, but with the wide variation in methods of construction it is impossible to do so for the reason that cars may have to be held for weeks for missing parts. Also it is necessary for each road to keep on hand a large and varying stock.

Efforts tending toward the development of a standard box car have been made in the past and a review of them is of interest. At the convention of the Master Car Builders' Association held at Saratoga in June, 1894, attention was called to the fact that the standards of the M. C. B. Association were not being generally adopted and it was moved that the attention of the American Railway Association be called to this with a

Wabash 80000 Pounds Capacity Steel Frame Car.



Application of Safety Devices to Pennsylvania Class X-24 Freight Cars.

view of securing its co-operation. The latter association adopted a resolution on October 17, 1894, to the effect that the details of car construction as adopted by the Master Car Builders' Association and published in 1894 be adopted as standard by the American Railway Association. In 1897 the M. C. B. committee on "Box Car Side Doors" reported details which were afterwards adopted as recommended practice. In the same year the M. C. B. committee of "Steel Underframing for Freight Cars" reported, designs being submitted by members of the committee as individuals. However, in order to obtain uniformity as to the several designs the committee met and agreed upon certain leading dimensions for a 60,000-pound capacity car, which were as follows:

Inside length	34 ft.
Inside width	8 ft. 4 in.
Width of side door (all cars)	5 ft. 4 in.
End doors, if used	24 in. wide by 36 in. high
Height, top of rail to top of floor	4 ft. 2 in.

These dimensions were arrived at after considering the replies to a circular sent to all roads. Few motive power officials were prepared at that time, however, to consider a car of greater than 60,000 pounds capacity. This committee was continued through the following year as a committee on "Steel Car Framing" and in 1898 presented several designs but expressed the belief that it was impossible at that time to design a steel car frame which would meet with universal favor.

The American Railway Association in 1899 appointed a committee on "Standard Dimensions of Box Cars" of which J. J. Turner was chairman. This committee made a thorough study of the subject covering over two years, and after taking into consideration railroad clearances, loading platforms and economy in construction, maintenance and operation, decided on a standard car with inside measurements as follows: Length, 36 ft.; width, 8 ft. 6 in.; height, 8 ft; with a 6-foot door opening. In order to create a desire for the standard dimension car the committee recommended that this car be considered the unit for the establishment of minimum car load weights and presented a table showing percentages of increase for all cars over 36 feet. At its meeting, in St. Louis on October 23, 1901, the American Railway Association adopted the above standard inside dimensions for box cars and at the same time a resolution was adopted requesting the Master Car Builders' Association to adopt

Pennsylvania Class X-23 Steel Frame Box Car.

external dimensions to conform to these interior dimensions. Thereupon the president of the Master Car Builders' Association appointed a committee to report on this subject. This committee, which reported in 1902, made the following recommendations as to external dimensions:

For box cars on high trucks (4 ft. to top of floor)—

Height from top of rail to upper edge of eaves to be 12 ft. 6¾ in.

Width at eaves to the above height, maximum, 9 ft. 7 in.

For box cars on low trucks (3 ft 6 in. to top of floor)—

Height from top of rail to upper edge of eaves, 12 ft. ¾ in.

Width at eaves at the above height, maximum, 9 ft. 7 in.

It will be noted that no recommendation was made as to external length. The committee was instructed to report in 1903 upon a system of framing, together with inside and outside dimensions. Thereupon the committee made a further report in 1903 covering a system of framing. There was much objection at this time to the 6-foot door opening, it being claimed that the large opening weakened the car, that the large doors had a tendency to warp and that it was necessary to use exceedingly heavy grain doors. The committee was increased to five members with instructions to further consider suitable design for a standard box car. The report presented in 1904 suggested that the recommendations made in 1902 with regard to outside dimensions be submitted to the Association and that the inside dimensions as approved by the American Railway Association be adopted. A system of side framing and end framing for 60,000-, 80,000- and 100,000-pound capacity box cars was also submitted. These recommendations were submitted to letter ballot and the inside dimensions, together with the system of framing, was adopted as recommended practice. The recommendation as to outside dimensions for high truck cars was rejected, but the recommendation as to dimensions for low truck cars was carried.

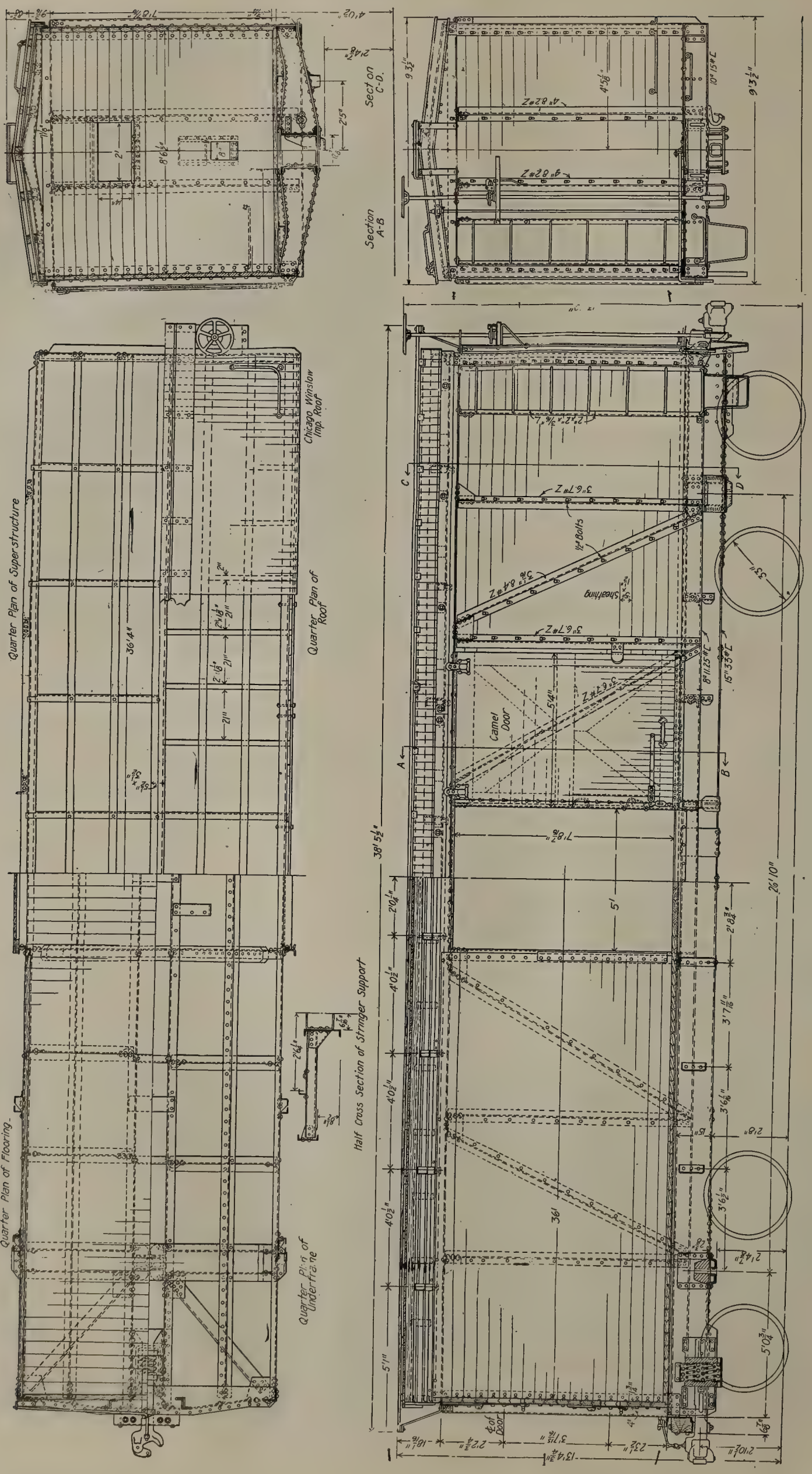
In 1908 an M. C. B. committee on "Lateral Bracing of Steel Freight Cars" made a report. This committee had been appointed to report on diagonal bracing in underframes and to investigate designs of upper framing of cars. The committee found a marked difference of opinion on the subject of underframes and only four roads reported as having experience with metal upperframing of cars. No conclusions were drawn and the committee did not believe that the work delegated to it by the Association could be accomplished with any degree of success at this time, and it was accordingly discharged.

In 1910 new designs for outside hung and flush side doors were adopted by the Master Car Builders' Association as recommended practice, representing the minimum requirements in door construction. The standard outside hung door is 6 ft. 5 in. in width and 8 ft. in height. It was also recommended that the door hood coverings be omitted from new cars, and as much as possible in repairs to old cars. The following year the location of the center of hasp or sealing eye was made preferably 5 feet from the top of the rail and not more than 5 feet 9 inches. In 1912 the door hasp staple was increased from 5⅜ inches to 16 inches and provided with four bolt holes. The drawings and details for side doors were made standard in 1912, the end door details remaining as recommended practice.

On January 1, 1902, the Official Classification Committee adopted the graded system of minimums for cars over 36 feet in length (as recommended by the American Railway Associa-

End View of Union Pacific Box Car.

Union Pacific 100000 Pounds Capacity Box Car.



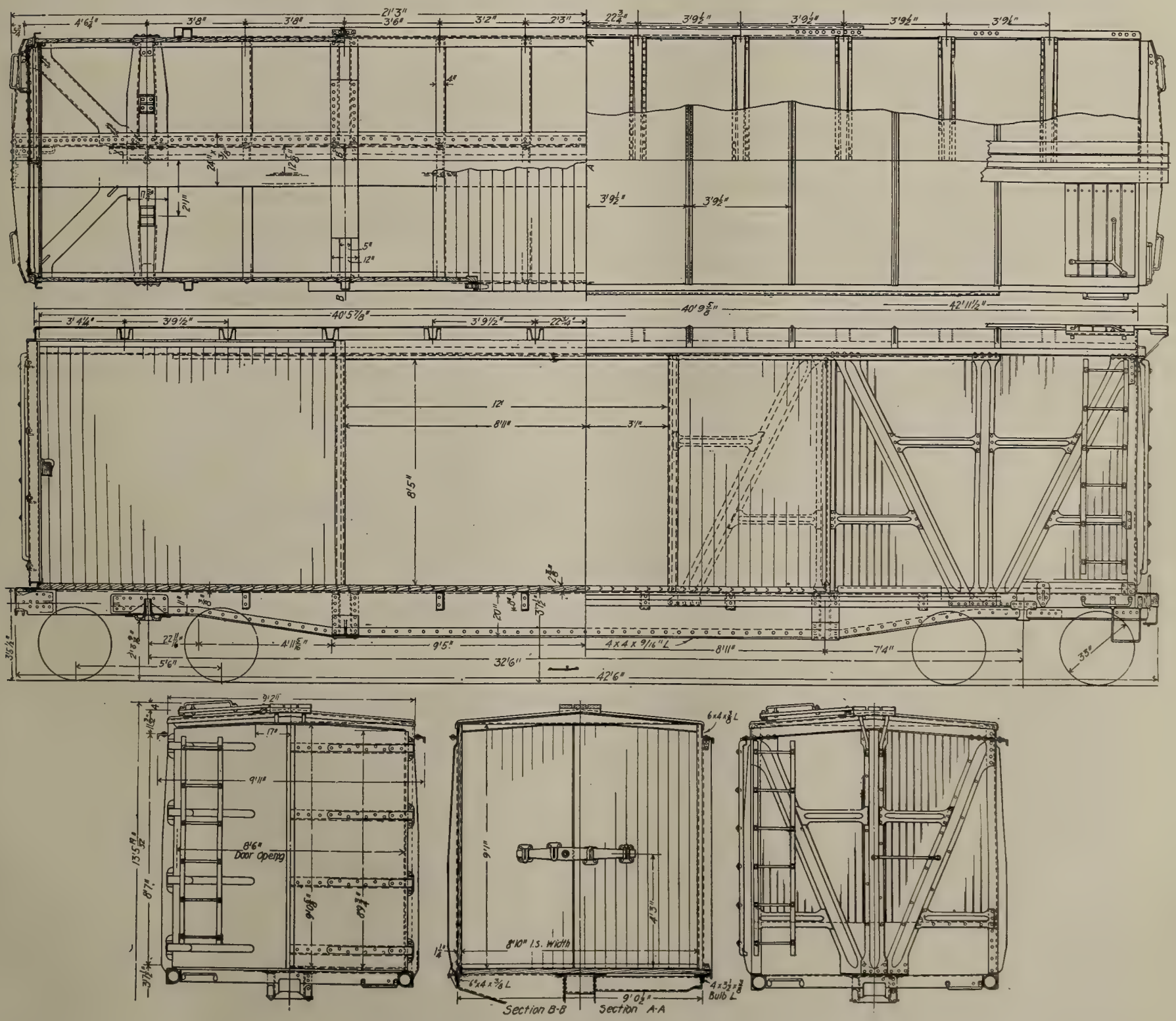
Plan, Elevation and Sections of Canadian Pacific Standard Box Car.

tion), and the Southern Classification Committee adopted it shortly after. The Western Classification Committee did not follow the recommendations of the American Railway Association, however. At its meeting in January, 1902, the 36-foot car was adopted as the unit for minimums, but the ratio of increase was made only 3 per cent for each foot over 36, which was much less than that recommended by the American Railway Association. The result of this has been a larger proportionate increase in the Western classification territory in cars over 36 feet in length, as the scale of minimums does not place a sufficient penalty on the large car. Thus, according to the latest statements of the American Railway Association, the increase in the number of cars over 36 feet long in the Western classification territory during the period from January 1, 1909, to January 1, 1912, has been 32.9 per cent, as against a decrease of 16.33 per cent in the Official territory, and an increase of .78 per cent in the Southern territory. For this same period the increase in cars 36 feet long has been 14.94 per cent in the Western classification territory, 31.43 per cent in the Official territory and 19.48 per cent in the Southern territory. For cars under 36 feet in length the decrease for the period mentioned has been 19.22 per cent in the Western classification territory, 21.64 per cent in the Official territory and 16.19 per cent in the Southern territory.

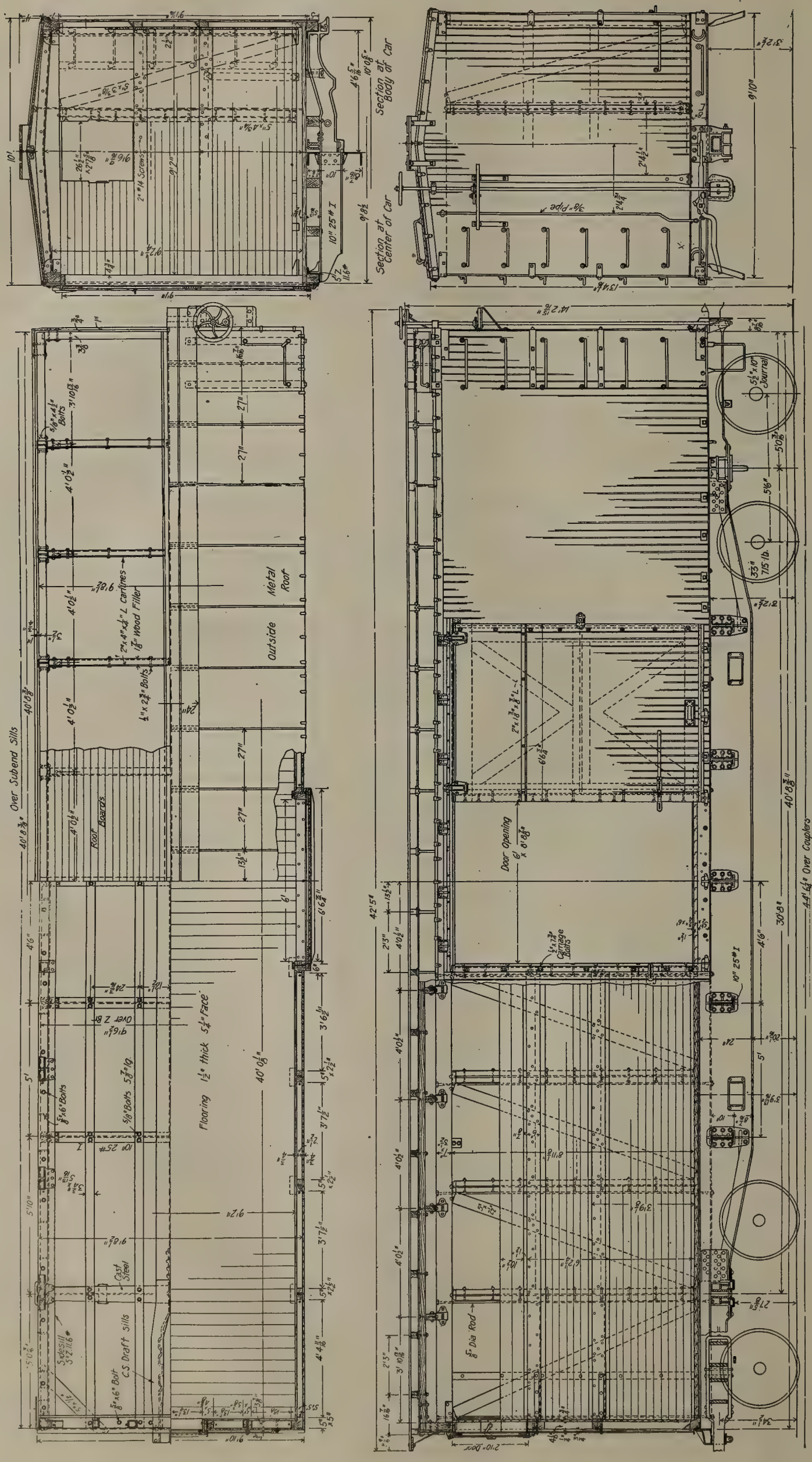
At the meeting of the American Railway Association held at Chicago, November 20, 1912, a sub-committee of the Committee on Maintenance made a report on "Standard Dimensions for Box Cars." This committee stated that since 1901 the cars 36 feet long have increased 796.92 per cent, while cars over that length have increased 45.34 per cent, but that there was quite a demand for a longer and higher car in all classification territories, particularly the Western, and the Official and Western. In order to ascertain what size a car might be built to and still come within the permissible clearances of today, the sub-committee sent out two circulars requesting information as to dimensions of box cars now in use. From this, and other information the sub-committee decided that a box car 40 ft. 6 in. long, 8 ft. 6 in. wide and 9 ft. high (inside measurements) is the largest car that can be constructed without interfering with any of the main line clearances. This car should be so constructed that its outside dimensions should not exceed 5 ft. 2 in. in width at a point 13 feet above the rail. The sub-committee called attention to the possibility of providing a frame of standard dimensions in case a change from the present dimensions was made, and suggested the following resolution:

"Resolved, That the Master Car Builders' Association be requested at the earliest practicable moment to proceed to design and adopt a standard frame for closed cars in accordance with the dimensions of box cars recommended."

A resolution was also submitted calling for submission to



Showing Views of Pennsylvania Class X24 Cars.


Section at Center of Car
Section at Body of Car
Metal Roof
Outside
Roof Boards
Flooring 1½" thick 5¼" Face
Over Subend Sills
Door Opening 6' 0 1/8" x 6' 0 1/8"
Union Pacific Standard Box Car.

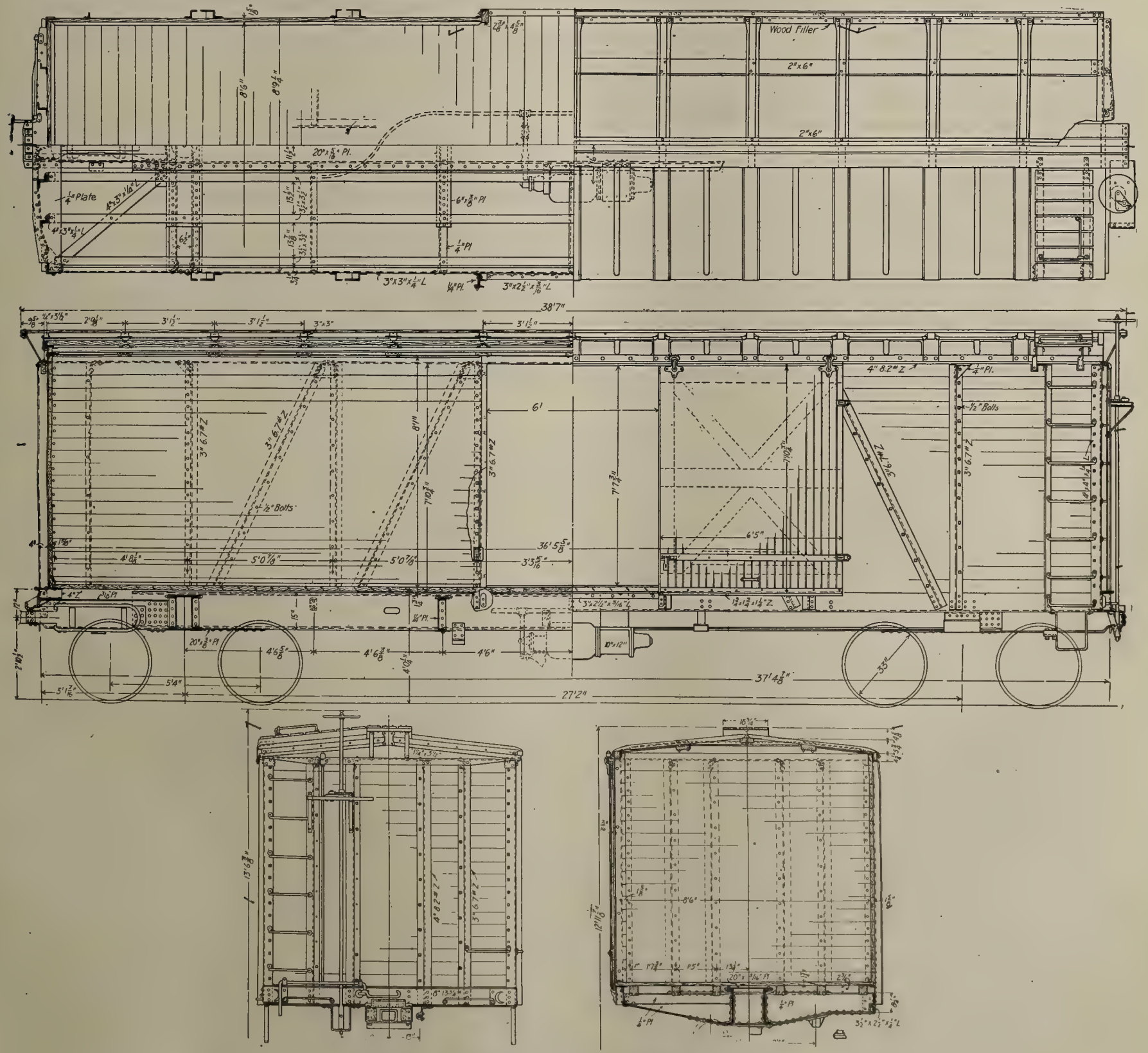
letter ballot the question of prohibiting the construction of cars with greater dimensions after a standard frame should have been adopted.

The report of the sub-committee was referred back to the committee on maintenance after a short discussion, with instructions to present a further report at the next session. At this session, held at New York on May 21, 1913, the committee reported that the question was being given careful consideration; that the subject had been taken up with several classification committees and that it was being developed as rapidly as possible considering its importance. No final report was presented. Thus it will be seen that the limiting dimensions of the standard box car are fairly well fixed, particularly as to height and width, as evinced by the report of the American Railway Association.

A number of efforts have been made in the past ten years in the direction of a standard box car, but the time has not seemed ripe. However, some progress has been made and it would seem that the time is not far distant when such a step will be taken. The steel frame box car has been developed to a point where its value has become established and its use has proved very successful on a number of roads. If the report of the sub-committee of the American Railway Association is eventually adopted, it will be the part of the Master Car Builders' Association to design a car which will conform to the dimensions given. We present herewith illustrations and other data with regard to the standards in box car construction on a number of roads, which is of considerable interest at this time, affording as it does a basis for comparison of the most up to date construction.

Harriman Lines.

In the line drawing and photographs is shown the latest type of box car in use on the Union Pacific and associated lines. This is a wooden upperframe car of 100,000 pounds capacity, with a Bettendorf steel underframe, Bettendorf truck, Miner roller side bearings and Barber truck roller device. The framing is composed of Oregon fir posts and braces with the exception of the side door, corner and end posts, which are of oak. The framing follows closely the recommended practice of the Master Car Builders' Association for cars of this capacity. All posts except the corner posts have ½-inch wrought iron flitch plates. The sheathing and lining is ¾-inch Oregon fir and the floor is 1½ inches thick with 5¼-inch face. The door opening is 6 ft. by 8 ft. 8⅞ in., and the door, while of the same general design as the M. C. B. door, is somewhat longer, being 6 ft. 6¾ in. by 9 ft. 1 in. The side door fixtures are of the Camel Security type with improved combined burglar proof lock and door stop.



Sections, Elevation and Plan of Wabash Box Cars.

The car has an end door with an opening 26½ ft. by 2 ft. 7⅝ in. The inside measurements are: length, 40 ft. ⅛ in.; width, 9 ft. 2 in., and height from floor to carline at sides, 9 ft. 2¼ in., from which it will be noted that the height and width are slightly in excess of the proposed American Railway Association requirements. The weight of the car light varies from 40,890 to 44,334 pounds, depending on the lumber used and the type of trucks. A 33-inch, 715-pound wheel is used. The draft gear is the Miner tandem type and the roof the Murphy outside metallic. Some of the principal dimensions are as follows: Length over running board, 42 ft. 5 in.; distance between truck centers, 30 ft. 8 in.; length over end plates, 40 ft, 8¾ in.; length over couplers, 44 ft. 6¼ in.

Pennsylvania.

The latest designs in box car construction in use on the Pennsylvania R. R. are designated as class X23 and class X24, class X24 differening from X23 only in that it is an automobile car with end doors and large side doors. The photograph shows class X23, while the drawing shows class X24. This type of car is of 100,000 pounds capacity and has a steel upper frame, with 1¼-inch sheathing of yellow pine. The posts and braces are ¼-inch O. H. S. pressed U shape. The carlines, of which there are ten, are also of the same shape and material. The underframe is of the fish belly type without bolsters. The center sills are ⅜ inch thick, 20 inches deep at the center and 11 inches at the center plate and draft. Side sills are ⅜ in. by 4 in. by 6 in. angles and there are two needle beams spaced 8 ft. 11 in. equi-distant from the center of the car. Westinghouse draft gear and Pennsylvania R. R. standard arch bar trucks are used. The inside length is 40 ft. 6 in. and the inside width 8 ft. 10 in. Length over all is 42 ft. 6 in. and width over all is 10 ft. 1 in. The class X23 car has an inside height of 8 ft. as compared with 9 ft. 1 in. in the class X24. Side door opening of class X23 is 6 ft. by 7 ft. 3⅝ in., while the side door opening of class X24 is 12 ft. wide by 8 ft. 5 in. high, which, with an end door opening of 8 ft. 6 in. by 8 ft. 9¾ in., makes it amply able to take care of automobile and carriage shipments.

This car illustrates the latest developments along the line of steel frame car construction and follows quite closely the proposed A. R. A. dimensions with the exception that the inside width is 4 inches in excess. About 5,000 of these cars have been built by the Pennsylvania during the past year.

Wabash.

The latest type of box car in use on this road is of 80,000 pounds capacity, with a steel upper framing and an all steel roof. The center sills are formed of two 13-inch channels with cover plate and extend 22 inches ahead of the body bolster. The body bolster is of the built up type, formed of pressed steel web plates and cover plates on top and bottom. The draft sills are independent and formed of pressed steel Z shapes riveted to the center sills. Side and end sills are 8-inch channels. The needle beams are of pressed steel extending from center to side sills with a pressed steel filler between center sills. The floor supports are also of pressed steel. The upperframing is of Z bar construction, the sheathing being placed inside. The posts and braces are 3-in. 6.7-lb. Z's, the side plates 4-in., while the end plates are a pressed steel shape.

The car has a length inside of 36 ft. 5⅝ in., width inside of 8 ft. 6 in., and an inside height of 8 ft. 1 in., with a 6-ft. door opening. Length over truck centers is 27 ft. 2 in. and over running board 38 ft. 7 in.

Canadian Pacific.

The steel frame box car originated on this road and the latest type 40-ton box car used on the Canadian Pacific might be adopted as standard by a number of other roads with considerable profit, as it has proved very successful on this road. The braces and posts are 3-in. Z bars varying in weight from 6.7 to 8.4 lbs. and the width of the car over these braces is 9 ft. 3½ in. Chicago Winslow improved roof is used and the side door is equipped with the Camel hanger and burglar-proof locking device. The door opening is but 5 feet, a 5-ft. 4-in. door being used. The car is equipped with an end door 14 inches high by 2 feet wide and a steel rail door with an opening 8 in. by 8 in., the plate for the latter being 9⅞ in. by 12⅝ in. The end door is an iron plate ⅛ in. by 19 in. by 25⅛ in. This door frame is welded into one piece and both end and rail doors are so made that they are tight when closed, making it unnecessary to provide inside doors. The car has a length over running boards of 38 ft. 5½ in., with inside dimensions as follows: Length, 36 feet; width, 8 feet 6½ inches, and height, 8 feet.

(To be continued.)

May Conventions

AIR BRAKE ASSOCIATION.

The twentieth annual convention of the Air Brake Association was held in St. Louis, May 6th to 9th, W. J. Hatch, of the Canadian Pacific, presiding. The meeting opened with a prayer by Rev. C. E. Jenney, and the association was welcomed to the city by T. H. Rogers, secretary to the mayor.

The secretary's report showed 788 members and a cash balance of $2,619. About 220 members registered the first day.

An informal meeting was held Tuesday afternoon for the discussion of topics of interest not included in the program. E. F. Kearney, general superintendent of transportation of the Missouri Pacific, addressed the convention Wednesday morning. Wednesday afternoon was given over to an informal talk by Walter V. Turner of the Westinghouse Company, who spoke on topics suggested by the members in attendance.

A paper on "Undesired Quick Action, Its Prevention and Remedy," was presented by C. N. Remfry, of the Duluth, Missabe & Northern. He told of the difficulties that had been experienced by that road, which has 7,000 ore cars and 2,000 freight cars. They are in service during the open season of the Great Lakes, which is approximately from April 15 to November 30. At the close of the season the brakes are cleaned and lubricated. Each ore car will average one round trip of 190 miles every 24 to 36 hours, and is examined by air brake inspectors after each trip. The terminal yard at Proctor, Minn., has 97 tracks, all of which are piped with air test lines. Sufficient air capacity is provided to charge 5 trains at once to a pressure of 90 lbs. The cars are braked at 95 per cent on a 50-lb. brake cylinder pressure. Prior to and including the year 1906 the triple valves were cleaned on the cars by removing the triple cap and check valve case, wiping the parts as clean as possible, and oiling the slide valve and slide valve piston. This method would give satisfactory results until warm weather, when the undesired quick action would develop on nearly all trains. It was believed that the accumulation of rust in the pipes and the ore dust working into the pipes would cause the triple to stick enough to hold the pressure until it became great enough to move the piston to the emergency position. With this idea in view the triples were given a much more thorough overhauling and the pipes were hammered and blown out, but in the following year the trouble was worse than ever. Drawbars were pulled out and the equipment became more or less weakened, putting about 20 per cent of the cars out of commission. At the end of the season, however, the triple valves seemed to be in as good condition as when the brakes were cleaned. A large number of the triple valves were then sent to the Westinghouse works at Wilmerding, Pa., for closer examination.

As a result it was decided to only blow out the air pipes, to give special attention to the cleaning of the triple valves, to use gasoline instead of kerosene in the cleaning, and to lubricate the slide valves with a high grade of fine dry graphite, and the triple piston with a good grade of grease or oil. This gave

the desired result, and at the end of the 1909 season there were only six cases of the undesired quick action. In each of these six cases it was found that oil on the slide valve caused the trouble.

F. B. Farmer, Westinghouse Air Brake Company, presented an interesting and instructive paper on "Starting, Running and Stopping Long Freight Trains," which included valuable instructions to engineers of freight trains.

A paper on the operation of triple valves was presented by S. W. Dudley of the Westinghouse Air Brake Company, who outlined in the first part the various external and internal conditions that affect the operation of the triple valve. The most important feature of the paper was a report of tests made by representatives of the Pennsylvania Lines and of the Westinghouse Air Brake Company to determine, comparatively, the effect of the more common circumstances affecting the service operation of the triple valve in modern passenger train service. A primary consideration was the relative effect of 1-in., 1¼-in. and 1½-in. brake pipe on the release, the service and the emergency functions of the quick action triple valve. Other considerations were the effect of main reservoir pressure, compressor capacity, design of triple valve, kind of service brake applications, use of full release position, single and double brake equipment per car, condition of triple valve, rate of recharge of auxiliary reservoirs permitted and brake pipe leakage.

A paper on air hose failures was read by T. W. Dow of the Erie. He said that several roads are making an accurate check of the cost of damage due to burst hose, intending to bring it before the M. C. B. Association to use as an argument for establishing a positive time limit in which to remove all hose from service. While the cost of such a practice might seem unwarranted and excessive to many, when it is compared with the cost of damage to equipment from the failure of the air hose it will be found that there will be a balance in favor of this practice. In checking several thousand 1⅜-in. air hose that had failed due to bursting, during the year 1912, the average life was found to be less than 20 months, and a small percentage of the number had been manufactured over 24 months; and it has been suggested by a number of mechanical officials that under the existing conditions it did not appear to be unreasonable to limit the service of air hose to the latter figure, or 24 months.

C. W. Martin (Penna.) presented a paper on the location of heat traps. He said: "To the air brake inspector in charge of equipment, who is called on to give an explanation of the cause of removal of wheels from passenger equipment cars which have been slid flat, the disposition of the water of condensation from the steam heat trap or drip becomes a serious problem. This condition has been considerably aggravated by the introduction of the steel car, which requires the number of square feet of heating surface to be more than doubled; this increases the amount of condensation to be discharged at the traps and usually requires more traps, due to the radiators being broken up into smaller units, because of the increased length of the vehicle. Where the traps cannot be located away from the truck or triple valve, some arrangement should be made to conduct the condensation close enough to the track to prevent flying back under the car. A sheet iron tube clamped to a trap of the vertical type conducts the water from the trap down close to the track, and where the trap is located near the center of the car, gives good satisfaction. A device made up from rubber hose, 4 inches in diameter, clamped to the trap and run as close to the track as desired, has also been found satisfactory. Where it is necessary to locate the traps outside the rail, this arrangement is preferable to either of those mentioned above. This is especially true when the cars are to be run in an electrified zone, where the third rail is used, as the hose is very flexible, not easily injured by striking any obstruction, and is a non-conductor. This matter is one which should be taken up by the car designers and builders, with a view to having these traps located at some point as far from the track as possible, and where this is not possible, to provide a suitable shield or guard to protect the brake rigging and equipment."

General.

The convention was addressed by J. F. Enright, superintendent of motive power and equipment of the Denver & Rio Grande. He spoke of the difficulties he experienced with cars received from valley roads where it was not as necessary to maintain the air brake system at such a high rate of efficiency as on mountain grades. The greatest trouble was found in lack of proper retaining valves.

The executive committee voted as the sense of the association against the formation of a supplymen's association to work in conjunction with the Air Brake Association, desiring to furnish their own entertainment at the conventions.

The following officers were elected for the ensuing year: W. J. Hatch, Canadian Pacific, president; L. H. Albers, New York Central Lines, first vice-president; J. T. Slattery, Denver & Rio Grande, second vice-president; T. W. Dow, Erie, third vice-president; F. M. Nellis, Westinghouse Air Brake Company, secretary, and Otto Best, Nathan Manufacturing Company, treasurer.

RAILWAY STOREKEEPERS' ASSOCIATION.

The tenth annual convention of the Railway Storekeepers' Association was held at Chicago, May 19 to 21, J. R. Mulroy, general storekeeper of the Pullman Company, presiding. The opening prayer was offered by Rev. William E. Barton. Eugene Chamberlain, manager equipment clearing house, New York Central Lines, made the opening address.

President Mulroy, in his address, commented on the important work accomplished by the association in raising the standard of the supply department and reported a material increase in the membership of the association.

G. G. Yeomans in an address emphasized the great opportunity of all storekeepers in furthering the success of their respective roads. Their opportunities are unbounded and their importance may be appreciated when it is remembered that they handle each year supplies valued at about $250,000,000. About 9 per cent of the gross earnings of railways is spent for material, or 17 per cent when fuel is included. The great possibilities for savings were illustrated by the fact that about $220,000,000 is invested in material, a decrease of which to the smallest degree would represent a considerable capital that could be used for other purposes. According to statistics all the roads are carrying a year's supply of material on hand, a condition which could be much improved by the combined action of the storekeepers with the other departments.

The secretary-treasurer's report showed a membership of 744, including 150 new members. There is a cash balance of $886.81 in the treasury.

A resolution was adopted inviting the arbitration committee of the M. C. B. Association to attend the meetings of the association and participate in the entertainment features.

Five papers were presented on "Reducing Inactive and Disposing of Obsolete Stock." The authors were, E. J. Roth (C. B. & Q.), H. A. Anderson (Penna.), E. J. McVeigh, W. D. Stokes (Ill. Cent.) and H. Stevens (Nat. of Mex.)

There were topical discussions on "Coupler Markings," "Specifications for Testing Material," "Rolling Mills for Scrap Docks," "Storage and Handling of Ice," "Oil House and Waste Storage," "Effect of Stores Department on Operating Cost" and "Storehouse Casting Platforms."

W. E. Hatter presented a paper on "Lumber Sheds." D. D. Cain (So. Pac.) and L. O. Genest (Can. Pac.) presented papers on "Standard Supply Car."

The following officers were elected for the ensuing year: President, J. W. Gerber, Southern Railway; first vice-president, G. G. Allen, Chicago, Milwaukee & St. Paul; second vice-president, H. C. Pearce, Southern Pacific, and secretary-treasurer, J. P. Murphy, Lake Shore & Michigan Southern.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.

The fifth annual convention of the International Railway Fuel Association was held in Chicago, May 21-24. President H. T. Bentley, principal assistant superintendent of motive power, Chicago & North Western, presided. The opening prayer was offered by Rev. William Carson Shaw.

The secretary reported a total of 523 members, which during the convention was increased to about 590. The total number of members attending the convention was 278.

Mr. Bentley commented on the rapid growth of the association since its inception five years ago, the membership having grown from 35 to over 500 members during that time. He pointed out that whereas 500,000,000 tons of coal are used annually, only 75,000,000 tons are actually turned into service and power, showing what a wide field of improvement was possible by fuel engineers. A great saving may be made by those having anything to do with fuel by carefully studying the various conditions under which they are handling it. Its constantly increasing cost requires that a special effort be made for the satisfactory use of the lower grades of coal. There are quantities of lignite beds throughout this country which, if a uniform supply was required, could be mined at a profit; therefore by stimulating its use a much cheaper fuel would be available. This fuel has been used successfully on locomotives and is also suitable for the production of producer gas. Attention was also directed to the fact that the coal could perhaps be obtained from the mines at a reduced cost during the summer months and stored with a net saving. Mention was made of fuel saved, due to the better design of locomotives and the use of superheaters.

Robert Quayle, superintendent of motive power, Chicago & North Western, mentioned the possibilities of increasing the thermal efficiency of locomotives. He agreed that the large grate area was more efficient for burning coal as suggested in Dr. Goss' paper of last year. Particular stress was laid on the proper preparation of the coal for the locomotive and of assisting the fireman as much as possible in the performance of his work. An important factor is the co-operation and team work between the engineer and fireman. The use of brick arches and superheaters was advocated, the latter to be applied to all classes of engines, even switchers.

A proposed standard form of contract covering the purchase of railway fuel coal was presented by a committee of which J. G. Crawford (C. B. & Q.) was chairman. One of the provisions on which there was a difference of opinion was the relation of car tonnage to the number of the purchaser's cars at the mine. Eugene McAuliffe (Frisco Lines) questioned the desirability of mentioning in the contract the number of cars to be supplied at the mine by the purchaser, while thoroughly believing that the purchaser should co-operate with the mine operator in this respect. He favored the storage of coal where practicable and strongly recommended that the invoices should carry the serial number of the contract. In considering the contracting of coal as a general proposition, Mr. McAuliffe pointed out that the condition of the mine should be considered by the railroad on whose line the mine was located, or on which the railroad relied for its coal supply. By this is meant the accepting of fuel that is not quite up to standard, but must be disposed of, the price, of course, being satisfactory to both the operator and the railroad. Other members suggested that the contract should include specifications as to the fusing point of the ash, the heat value, the percentage of ash in the coal, and a standard method of obtaining samples.

Samuel B. Flagg, engineer, Department of the Interior, Bureau of Mines, read a paper on "Sub-Bituminous and Lignitic Coals."

S. T. Dodd and B. H. Arnold of the engineering department of the General Electric Company presented a paper on "Self-Propelled Cars," which considered all types of self-propelled cars, but went more thoroughly into the discussion of those with internal combustion engines.

A progress report of the committee on modern locomotive coaling stations, of which Hiram J. Slifer, consulting engineer, is chairman, was presented. The committee, realizing that no definite design of coaling station could be made to fit the conditions of all climates, has only considered certain dominant factors that pertain in all cases. The committee recommended that a careful study regarding the character and permanency of the fuel supply be made before constructing permanent chutes; that the coaling stations be located away from the terminal a distance equal to that which can be covered by one tank supply of coal, and that no engines, except possibly one or two fast passenger engines, be coaled at the larger terminals. This recommendation, of course, being subject to the prevailing conditions. Forty-one questions were sent to the members for reply, but sufficient information has not been collected to make possible a complete report.

J. S. Sheafe (Ill. Cent.), chairman, read the committee report on "Locomotive Boiler Scale." The committee was unable to secure much data on the subject of heat loss due to boiler scale, and believes that such loss is considerably over-estimated. It was pointed out that in order to keep the tubes 100 per cent clean the tube borers should be educated as to the importance of doing their work in a thorough manner and that they should be carefully watched by the foreman in charge. Convenient and accessible plugs should be supplied in order to thoroughly inspect the boiler after it has been washed out. Larger arch tubes were recommended to adequately take care of the steam generated in them. The ideal way to treat water is in settling tanks so that it may be commercially pure before being put in the boiler. The adding of a boiler compound by the guess method is to be generally discouraged, and each treatment should be chemically correct, as much harm may be done otherwise.

J. A. Garcia, Allen & Garcia Company, Chicago, presented an interesting paper on "Construction, Development and Operation of a Bituminous Coal Mine," describing the latest practices in mine operation. He stated that an extraction of 75 per cent should be made from a mine properly developed and operated 200 to 250 days per year. In the section of the country about Chicago the percentage of extraction is about 56 per cent. The remaining 44 per cent is allowed to remain, as it would cost more to mine it than its price on the market. The best of engineering practice is required in the construction of a mine to insure its permanency and safety. It was stated that track scales under the tipple were unsatisfactory and should be so located only when it is not possible to secure the proper gradient.

A committee, of which D. C. Buell was chairman, presented a report on what it considered the best practice in firing locomotives. It was well received and thoroughly discussed by the association. The different items included firing tools, draft appliances and blower, care of boiler tubes, hand firing, mechanical stoking, education of firemen, interesting railroad officers in fuel economy, waste of coal for which the fireman is responsible and methods of obtaining the co-operation of the fireman. The committee is to incorporate in its next report the suggestions adopted during the discussion, together with designs of the best practice in firing tools.

The following officers were elected for the ensuing year: President, R. Collett, superintendent of fuel service, Frisco Lines; first vice-president, D. R. Sebastian, fuel agent, Chicago, Rock Island & Pacific; second vice-president, D. C. Buell, chief educational bureau, Union Pacific, Illinois Central and Central of Georgia. Executive committee, two years, B. P. Phillippe, C. F. Ludington, J. S. Sheafe and F. F. Gaines; for one year, Eugene McAuliffe and W. H. Averill.

MASTER BOILER MAKERS' ASSOCIATION.

The seventh annual convention of the Master Boiler Makers' Association was held in Chicago, May 26 to 29, President M. O'Connor, general foreman boiler maker, Chicago & North Western, presiding. John H. Smythe, Parkesburg Iron Com-

pany, made the opening prayer. Addresses were then made by W. L. Park, vice-president of the Illinois Central, and John F. Ensign, chief boiler inspector, Interstate Commerce Commission.

J. F. Ensign, in an address, called attention to the moral obligation of the boiler makers, not only to their employers but to the general public, by being sure that the locomotive boilers are in an absolutely safe condition before they are sent out on the road. He emphasized the importance of having men perform the inspections who thoroughly realize the importance of their work, and who would insist that the necessary repairs be made before the engine was allowed to be used. He favored the placing of a boiler maker in charge of all work done on a boiler, such as the installation of the various boiler appurtenances. From July 1, 1911, to December 31, 1912, 16 deaths and 1,383 injuries were due to the failure of these appurtenances, which could have been easily repaired had they been given the proper inspection.

President O'Connor spoke of the responsibility of the boiler maker, urging the members to carefully study the difficult problems that frequently arise in the work of boiler construction. In speaking of the apprentices he said: "We should do everything we can to encourage and help them and by their examples they will lead other men who are selected to fill their places, if only they are taught to show that mental culture on moral and mechanical ideas is a pleasure to them as well as a duty."

The secretary reported a total membership of 415, with 313 in good standing. Sixty-eight applications for new members were received the first day of the convention. The treasurer reported a cash balance of $441.67.

C. A. Seley, president of the American Flexible Bolt Company, addressed the convention Tuesday morning. Speaking of railroad legislation he emphasized the statements made by speakers on the first day of the convention concerning the civic duty of the railroad employees and suggested that the members advise their representatives concerning intended laws which especially concern their work. Railroads are the only corporations that have government regulation without being allowed to set the price of their products and should have the employees' co-operation. He mentioned the efficient way in which the boiler inspection laws are being enforced.

J. J. Doarnberger (N. & W.), chairman of the committee on "Midway Supports for Boiler Tubes;" presented the report and spoke of tthe general tendency toward the longer tube, the greatest length being 24 ft. when 2½-in. tubes were used and 22 ft. for the 2-in. tube. The 22-ft. tube does not seem to require the intermediate support, the buoyancy of the water being sufficient to support the tubes between the tube sheets. While there have been intermediate supports applied experimentally they were of such design as to make the removal of the tube an expensive and difficult proposition. A good rule deduced from tests and experience shows that so long as the length of tube does not exceed 110 diameters (outside measurements) satisfactory results may be obtained. Good results have been reported from the 24-ft. tube, 2¼-in. diameter, with the intermediate support, but the difficulty of removing the tubes still remains; while tubes of this diameter have been installed without the support there is no available data as to the results. The two prime objections to the long tubes are, first, their manufacture, and second, the efficiency of their supports and the retardation of the gases. While the long tubes receive material support from the water they are liable to spring leaks when the boiler is hauled over the road empty.

A committee, of which E. W. Young, Interstate Commerce Commission, was chairman, presented a report on "When is a Boiler in a Weak and Unsafe Condition?" in which were mentioned as the causes of boiler trouble the faulty and defective design, poor material, poor and careless workmanship, improperly made repairs, bad water and improper care. Among the contributory causes were mentioned the rigidity of construction which would not allow for free expansion and contraction; this might be caused by too rigid staying and the improper location of the stays.

It was the opinion of the committee reporting on "Welding Superheater Flues" that all safe-ending should be done at the firebox end, thereby always having good and new material at the place it is most needed. It is necessary to keep these large flues tight at all times to obtain successful results. The demands on a superheater flue at the firebox end are as great if not greater than on an ordinary tube, and under some conditions, such as bad water and the failure to keep them absolutely clean, they are very liable to give trouble and require considerable work to keep them tight. There should not be more than one weld in these flues at any time, as old welds will give trouble. To do this it is necessary when safe-ending to cut the tubes as close to the tube sheet as possible; the first end should be 5 in. long, the second 8 in., the third 11 in. and the fourth 14 in., which is possible with the average flue welding machine.

C. L. Hempel (U. P.), chairman, reported that the committee on "Effect of Superheaters on the Life of Fireboxes and Flues" had gathered information from several railroads having engines equipped with superheaters of the Baldwin, Vaughn-Horsey and Schmidt type, the steam pressure ranging from 165 to 200 lbs., and that the committee is unable to find any well founded claim to show that superheating of steam has a detrimental effect upon the fireboxes or flues, but, to the contrary, it is shown that the life of the fireboxes and flues is prolonged considerably, from the fact that where steam is superheated the working pressure is reduced. However, there are many large engines carrying 200 lbs. working pressure with superheaters that show no ill effect on fireboxes or flues.

Robert Quayle, superintendent motive power and machinery, Chicago & NorthWestern, addressed the convention Wednesday morning. He urged the members to participate more freely in the discussions and to bring new ideas to the convention each year. They should know just what kind of material was being used in the shop, and what was the best material for each purpose. Information along these lines should be sought for in books and from experts. He commented on the ill effects of punching sheets and predicted a discontinuance of the practice. Special care should be taken when laying-out so as to avoid the use of drift pins. Boiler makers should be honest and fair to themselves and not allow bad work to go out of the shop. Treat the government inspectors fairly and aid them in their work, for the locomotive boiler inspection law is a great thing. Superheaters add to the life of the boilers and should be used on all locomotives. The more extensive use of welding in boiler work is to be commended.

Frank McNamany, assistant chief boiler inspector, urged the men to aid the government inspectors so as to get the best possible results. The law represents the best practice and is entirely practical.

A. N. Lucas (C. M. & St. P.), chairman of the committee on "Oxy-Acetylene and Electric Welding for Boiler Repairs," reported the successful use of both these welding processes in many railroad shops. One of the greatest savings made with the oxy-acetylene process is the cutting out of old or damaged parts. Both processes are used for welding cracked sheets, patches, pitted shells and tubes, etc. Difficulty has been experienced in welding vertical cracks, but this has been overcome by making the patch oval instead of rectangular. Some railroads are cutting their superheater unit pipes and welding them with the oxy-acetylene process. The chief objection to the electric welding process is that no cutting can be done with it, and although it does very good welding it is not as fast as the oxy-acetylene.

C. J. Murray (So. Pac.) strongly recommended the rocking finger grate for bituminous coal-burning engines. On the Chicago & North Western a close meshed grate, similar to what is used on the hard coal burning engines on the Delaware, Lackawanna & Western, is used on locomotives burning lignite with good success. On oil burning engines there are no grates, but

the ash pan, or brick pan as it is called, must be absolutely air tight.

F. D. Timms (C. H. & D.) also recommended rocking finger grates, the fingers to be 6 in. in length and the dump grates at the rear of the firebox. A good steady fire can be maintained on these grates, and when dumping the fingers will crush the clinkers, and at the same time force them into the ash pan.

The committee on "Effect of Chemically Treated Water on Boilers," of which A. E. Shaule (D. M. & N.) was chairman, sent out questions to the members from which it was determined that good results had been obtained from the use of soda ash and caustic soda. There is some difference of opinion as to benefits derived from treated water as a preventive of corrosion. One member reported the use of a polarized metallic preparation, applied direct to the boilers in bars distributed over crown sheet and tubes before closing the boiler and after each washout. This produces an effect more mechanical than chemical; it has an affinity for the material the boiler is made of and forms an amalgam over the boiler plates and tubes which prevents scale forming, also in the case of dirty or scaly boiler the fissures in the scale render it susceptible to removal because the material gets access to the plates and tubes through them, resulting in the scale becoming rapidly loosened and removed, falling to the mud ring or to the bottom of the boiler under the tubes, where it is blown or washed out. Local conditions govern the application of the treatment. The cost of treating water is 4 cents per 1,000 gals. on the Santa Fe; and 2 to 5 cents, according to conditions, on the Canadian Pacific. The polarized treatment costs about 3 cents per 1,000 gals.

The following officers were elected for the ensuing year: Thos. W. Lowe (Can. Pac.), president; Jas. T. Johnson (A. T. & S. F.), vice-president; Andrew Greene (C. C. C. & St. L.), vice-president; D. A. Lucas (C. B. & Q.), vice-president; John Tate (Penna.), vice-president; Chas. P. Patrick (Erie) vice-president; Harry D. Vought, secretary; Frank Gray (C. & A.), treasurer.

WESTERN RAILWAY CLUB.

The annual meeting of the Western Railway Club was held at the Auditorium Hotel, Chicago, on Tuesday evening, May 27. Following the report of the secretary and treasurer, the election of officers for the ensuing year was held and resulted as follows: President, Henry La Rue; first vice-president, W. B. Hall, Union Railway Equipment Co.; second vice-president, E. W. Pratt, assistant superintendent of motive power, Chicago & North Western Ry.; secretary and treasurer, J. W. Taylor. As is the usual custom of the club at the last meeting of the season, the remainder of the evening was devoted to a vaudeville entertainment, the talent being furnished by a number of supply men and railway men. During the short interval between the business program and the entertainment, the club listened to short talks by Henry La Rue, the newly-elected president, E. W. Pratt and "Jimmie" De Voy. Pratt started out by saying that if De Voy was there he would call on him to make his speech, but just then he discovered that De Voy had slipped in. Of course no man from the North Western can get up and talk, and go unchallenged by that sterling representative of the St. Paul. Anyhow, the club looks for something from Jim at every meeting and he is always there with the goods. This meeting was no exception. He urged more of the younger members to get up and talk, saying that all many of them lacked was nerve. A. H. Egan, recently appointed general superintendent of the Yazoo & Mississippi Valley, also gave the club a talk covering incidents in connection with his career. The vaudeville program was as follows:

MENU

W. B. Hall, Manager
Union Railway Equipment Company
A BANQUET

Frank Ryan.....Toastmaster
Pittsburgh Spring & Steel Co.

1. Western Railway Club Troubadours.....Stein Song
2. J. M. Hahn.....Piano Solo
Rudolph Wurlitzer Co.
3. W. E. Kelly.....Songs
Patton Paint Co.
4. Gus Voss.....Pianologue
Illinois Trust & Savings Bank
5. Fred S. Hickey.....Character Songs
Dearborn Chemical Co.
6. Western Railway Club Famous Band.....Selections
All Germans.
7. George H. Porter, Western Electric Co. and Jos. H. Kuhns, Republic Rubber Co.....The Cabaret Twins
8. Frank Barnard.....Songs
The Frictionless Rail.
9. Jack Ponic.....A Political Discourse
"The Coming President with the Future Flag."
Rhode Island Union.
10. The Band.....Some Musical Interpretations

The band which made its first appearance last year amply demonstrated what a year's time will do. The band is becoming one of the features of these entertainments. Its members are as follows:

Director: Mr. Jack Ponic
Instrumentationist: Mr. George Bryant

A. N. Forsythe.....E-flat Cornet
Forsythe-Harding Paper Co.
J. Will Johnson.....B-flat Cornet
Pyle National Electric Headlight Co.
George Royal.....Baritone
Nathan Manufacturing Co.
C. B. Royal.....Slide Trombone
Standard Oil Co.
J. W. Taylor.....Alto
Secretary, The Club.
G. H. Bryant.....Tuba
Thos. Prosser & Son.
John Ball.....Sousaphone
Chicago & Northwestern Railway.
W. O. Bendfelt.....Snare Drum
Western Electric Co.
W. B. Hall.....Bass Drum
Union Railway Equipment Co.

ILLUMINATING ENGINEERING SOCIETY.

At a meeting of the Convention Committee of the Illuminating Engineering Society held in Pittsburgh, Friday, May 16th, it was decided to hold the next annual convention in that city during the week of September 22nd.

The convention committee consists of Mr. C. A. Littlefield, New York Edison Company, chairman; Mr. P. S. Millar, Electrical Testing Laboratories, president of the society; Mr. H. S. Evans, Macbeth Evans Glass Company, Pittsburgh, Pa.; Mr. W. A. Donkin, Contract Manager of the Duquesne Light Company, Pittsburgh, Pa.; Mr. D. McFarlan Moore, General Electric Company, Harrison, N. J.; Mr. M. C. Rypinski, Westinghouse Electric & Mfg. Co., New York; Mr. J. C. Mundo, General Electric Company, Pittsburgh, Pa.; Mr. J. C. McQuiston, Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.; Mr. W. R. Serrill, United Gas Improvement Company, Philadelphia, Pa.; Mr. S. B. Stewart, Philadelphia Company, Pittsburgh, Pa.; Mr. T. J. Pace, Westinghouse Electric & Mfg. Company, Pittsburgh, Pa.; and Prof. H. S. Hower, Carnegie Technical Schools, chairman of the Local Section of the Society.

Mr. W. A. Donkin of the Duquesne Light Company, was selected as chairman of the local Committee on Arrangement, which will have charge of the convention. Mr. J. C. McQuiston of the Westinghouse Electric & Mfg. Company, was appointed

chairman of the Publicity Committee and will make all arrangements for advertising the convention.

It is expected that several hundred engineers from all parts of the country interested in lighting in its various forms will be present, and the program, details of which have not as yet been completed will consist, in addition to the technical sessions, of a reception and dance, several excursion trips and visits to the various industries in Pittsburgh.

INTERNATIONAL ENGINEERING CONGRESS.

In connection with the Panama-Pacific International Exposition which will be held in San Francisco in 1915, there will be an International Engineering Congress, in which engineers throughout the world will be invited to participate. The congress is to be conducted under the auspices of the following five national engineering societies: American Society of Civil Engineers, American Institute of Mining Engineers, the American Society of Mechanical Engineers, American Institute of Electrical Engineers and the Society of Naval Architects and Marine Engineers. These societies, acting in co-operation, have appointed a permanent committee of management, consisting of the presidents and secretaries of each of the societies, and eighteen members resident in San Francisco.

The committee has effected a permanent organization, with Prof. William F. Durand as chairman, and W. A. Cattell as secretary-treasurer, and has established executive offices in the Foxcroft Building, 68 Post street, San Francisco. The ten members of the committee, consisting of the presidents and secretaries of the five national societies will constitute a committee on participation, through whom all invitations to participate in the congress will be issued to governments, engineering societies and individuals.

The personnel of this committee is as follows:

Committee on Participation—Charles F. Rand, chairman; Charles Warren Hunt, secretary; D. H. Cox, W. F. M. Goss, F. L. Hutchinson, Ralph Davenport Mershon, Calvin W. Rice, Bradley Stoughton, George F. Swain and Robert M. Thompson.

The actual management of the congress and the work of securing and publishing papers will be in charge of the members of the committee resident in San Francisco. The honorary officers of the congress will consist of a president and a number of vice-presidents selected from among the most distinguished engineers of this and foreign countries.

The papers presented at the congress will naturally be divided into groups or sections. During the congress each section will hold independent sessions, which will be presided over by a chairman eminent in the branches of engineering covered by his section. The scope of the congress has not as yet been definitely determined, but it is hoped to make it widely representative of the best engineering practice throughout the world, and it is intended that the papers, discussions and proceedings shall constitute an adequate review of the progress made during the past decade and an authoritative presentation of the latest developments and most approved practices in the various branches of engineering work.

The papers, which will be collected and published by the congress, should form a valuable engineering library, and it is intended that this publication shall be in such form and at such cost as to become available to the greatest possible number.

Calgary Shops, Canadian Pacific Ry.

The Canadian Pacific has recently put in operation near Calgary, Alberta Province, Canada, a large shop plant of more than ordinary interest by reason of its size, its complete and modern character and the speed with which it was created.

The work was designed and built in its entirety by Westinghouse, Church, Kerr & Co., consulting and constructing engineers, of Montreal and New York, working under the direction of J. G. Sullivan, chief engineer of the Western Lines of the Canadian Pacific, and N. E. Brooks, division engineer.

The shop location is at Ogden (named in honor of a vice-president of the railway), and is 4½ miles from Calgary and about 2,250 miles from Montreal. Its distance from those sections of the country where the greater part of the construction materials, machinery and equipment were produced, constituted the first and one of the most important problems. A second important problem arose on account of the construction season being extremely short, owing to the high latitude, frost remaining in the ground until about April 1 and returning with snow as early as October 1. A third very important problem was the comparative scarcity of labor in the Canadian northwest, this condition being greatly aggravated during the late summer months when harvesting begins and all labor markets are practically drained of men.

Plans had, therefore, to be drawn, materials ordered, deliveries made and complete field organization perfected so that the shops could be closed in between April 1 and December 1 and sufficiently heated so that inside work could be continued after cold weather had set in. How this was done will be seen by the following progress diagram:

The shops consist in general of:

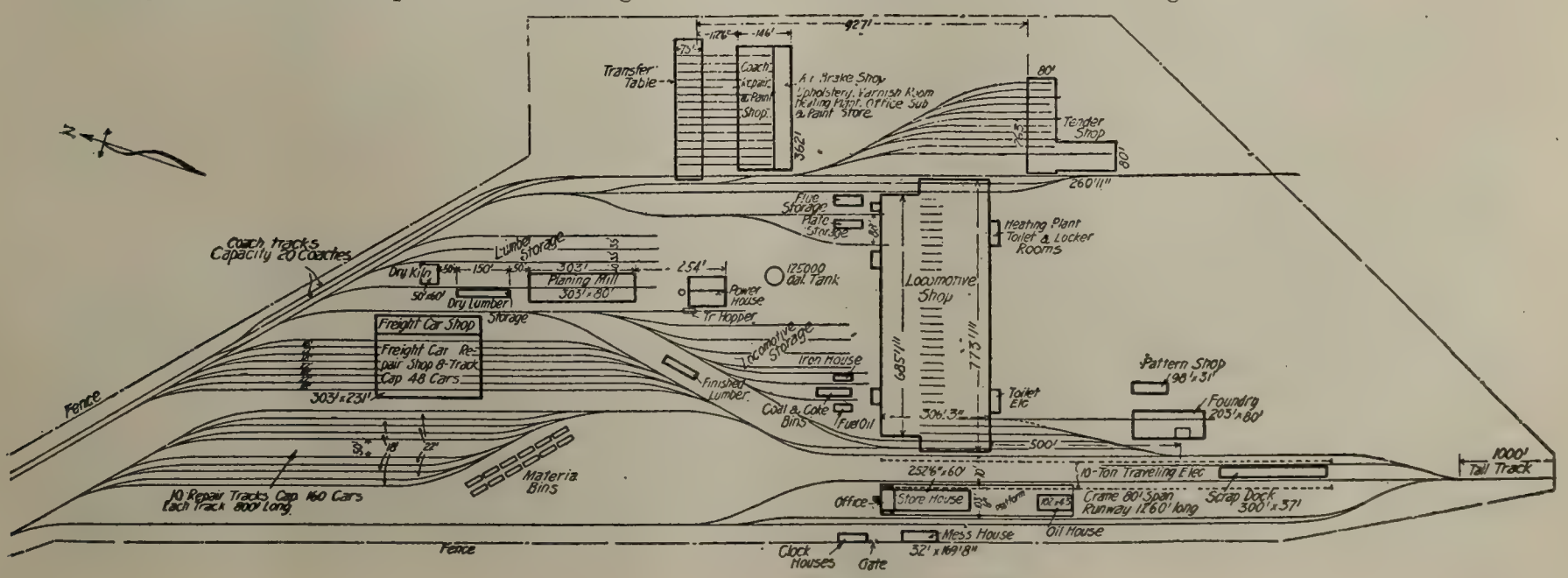
Main locomotive shop, including erecting, machine, blacksmith and boiler shops.

Tender and wheel shops.

Pattern shop and pattern storage.

Foundry.

Storehouse and office building.



Layout of the Calgary Shops, Canadian Pacific Ry.

Material platform and scrap dock.
Oil house.
Coach repair and paint shop.
Freight car repair shop.
Planing mill.
Boiler and compressor house.
1,260-ft. yard-crane.

Miscellaneous structures, including transfer table and pit for coach shop, mess hall, driven wells and water tower, all service system, such as drainage, sewage, fire protection, water supply, etc.

Main Locomotive Shop.

This building is designed to contain the erecting shop, machine shop, blacksmith shop and boiler shop.

The erecting shop is of the transverse lift-over type, contains 35 bays, each 22 feet between center, and is 778′ long by 75′ wide. The entire area is served by two traveling electric cranes, carried on two levels. A 120-ton crane, furnished with two 60-ton trolleys, is carried on the upper level and is used for transferring, wheeling and unwheeling locomotives and handling parts. One of the trolleys on this crane is equipped with a ten-ton auxiliary hoist for handling light material at a high hoisting speed.

Another ten-ton traveling electric crane operates at high speed and serves the entire area of the erecting shop, for handling material in that shop and transferring same to the blacksmith shop and machine shop. The machine shop and the boiler shop are located in adjacent bays on either side of the erecting shop.

Provision is made on the crane columns in the erecting shop for attaching portable jib cranes for use in dismantling and erecting material on the front ends of locomotives. These cranes are placed where desired by means of the overhead traveling electric cranes.

Entrance for locomotives to the erecting shop is provided through four doors, located in the west side of the shop, two of these doors being located at either end.

For providing additional means for entrance of locomotives, six door openings are provided in the east wall of the machine shop, two of these being at the north end and four at the south end.

All of these entrance tracks are connected up with the erecting pits of the several stalls where they enter the building, to permit of the locomotives moving into and out of the shop through these entrances should this movement become desirable or necessary.

The machine shop to contain heavy machine tools is located parallel with and adjoining the erecting shop on one side and is 60 ft. 9 in. wide and the same length as the erecting shop. A high speed traveling crane of ten-ton capacity covers the entire area of this shop. Material can be brought into the shop through a door provided in the end of the building, the material being brought up to the end of the machine shop by the traveling electric yard crane which travels across the end and outside of the locomotive shop.

Space for the lighter machine tools is provided in a shop 60 ft. 9 in. wide parallel with and alongside of the heavy machine shop and of the same length as that shop. An overhead trolley beam is provided on the bottom chord of the roof truss to permit of using a traveling electric trolley for handling material longitudinally in this shop. Provision has been made for a foreman's office elevated above the floor and having liberal glass surface in the walls so as to give the best possible view of the shop.

Interior of Calgary Locomotive Shop Showing 20 ton Crane.

The blacksmith shop is located alongside of and parallel with the erecting shop on the opposite side from the machine shop. This building consists of two bays each 332 ft. long, 60 ft. 9 in. and 50 ft. wide, respectively.

Space is provided for heavy forging work, steam hammers, etc., in the building immediately adjoining the erecting shop.

The blacksmith shop will not be served by a traveling crane, but provision has been made for jig cranes to handle the material from steam hammers, forgings, etc.

In a building of lower cross-section alongside are located the furnaces, bolt headers and other blacksmith shop machinery. This portion of the shop is served by a trolley its full length to facilitate the longitudinal movement of material through the shop.

Main Building from West, showing Blacksmith and Boiler Shop Bays, Calgary Shops.

The space for the boiler shop is provided in a two-bay building alongside of and parallel with the erecting shop at the end of the blacksmith shop, 352 ft. long and the same width as the latter shop.

That part of the boiler shop immediately adjoining the erecting shop is provided with a 40-ton traveling electric crane equipped with two 20-ton trolleys serving the entire area of the boiler shop for handling the boilers and other material.

The riveting tower is located between two of the roof trusses in the end of the boiler shop, with a 25-ton crane for serving the hydraulic riveter.

In the outer of the two bays of the boiler shop space is provided for a flue shop and boiler shop tools. The entire length of this space is served by a 3-ton overhead traveling trolley for handling material through the shop. Space for a flue rattler is provided immediately outside of and adjacent to the low bay of the boiler shop.

An entrance track is provided through the outside wall of the boiler shop on which boilers or other equipment going to this department can be delivered on cars under the traveling crane, for unloading, or may be loaded out for shipment in the same way. This facilitates the handling of boilers from steam shovels, pile drivers, Lidgerwoods, etc.

Jib cranes are provided for serving the individual machines in the boiler shop where such service may be necessary.

The heating throughout is done by indirect fan system. For distributing the heated air underground concrete and tile ducts are used.

The general illumination consists of Cooper-Hewitt lamps with circuit and plug boxes for extension loop cords. Provision has also been made for incandescent lighting circuits for individual lighting at machine tools where required, and for outlet boxes for connecting extension lamp cords to provide lighting for the interior of the locomotive boilers on the erecting floor.

Toilets, lavatories and metal lockers are provided in the various departments of this shop.

A suitable system of piping is provided for distributing live steam, compressed air, fuel oil and water for fire protection, drinking and hydraulic pressure.

Outlets for compressed air are provided in duplicate in the sides of each of the engine pits to supply compressed air for operating pneumatic tools.

In the main locomotive shop the electrical feeders from the power company transmission lines are carried in underground ducts, bringing the current at the voltage delivered by the power company, namely, 2,200 volts, to a sub-station located adjacent to and immediately outside of the low machine bay, the transformers for stepping down to 440 volts being located in this sub-station. In this sub-station two motor generator sets for supplying direct current are also located. The switchboard is also

Coach Repair Shop, Calgary Shops of the Canadian Pacific.

located in this sub-station for controlling the power and lighting circuits in the machine shop and for the tender shop and foundry. As far as possible distributing feeders are carried in conduit beneath the shop floor, thereby minimizing the amount of exposed wiring in the shops.

The building containing all of the above departments of the locomotive shop is constructed with structural steel frame carried on concrete foundations.

Ample window area is provided in the side walls and in roof monitors and skylights so as to give sufficient natural lighting.

Good ventilation is obtained through ventilators in the monitors and skylights and by the use of swinging sash in the vertical walls.

With the exception of the blacksmith shop and a portion of the boiler shop, the floor throughout is constructed with a 1½ in. asphalt mastic wearing surface, which is underlaid with a rough concrete slab about 6 in. thick. In the blacksmith shop and a portion of the boiler shop the floor is of cinders.

The roof sheathing is constructed of 2x4's, surfaced on one side and one edge and spiked together on edge, thus affording good fire resistance qualities and materially reducing the heat losses. The roof water-proofing is four-ply tarred felt, pitch and gravel, with copper flashing. Suitable drain leaders are provided and connected into underground tiled drains to carry off the water from the roof.

The large skylight on the erecting shop bay is of steel bars lead covered with ribbed wired glass.

Tender and Wheel Shop.

This building is constructed with structural steel frame and with steel roof trusses, otherwise the general construction of the building is similar to that described for the main locomotive shop. It is an L-shaped structure 263′ x 80′ wide with L 180′ long by 80′ wide, and affords space for making repairs to locomotive tenders, steam-shovels and other maintenance of way equipment.

That portion of the shop intended to receive the equipment to be repaired is spanned over its entire area by a 20-ton high-speed traveling electric crane equipped with two ten-ton trolleys.

Longitudinal tracks on 20-foot centers extend to the doors in the building wall.

A car puller is installed for moving the equipment into and out of the shop.

A sufficient number of tracks extend through the rear wall of the building to facilitate the movement of material into the shop.

In the L portion of the building, of lower cross section, space is provided for steel tire wheel lathes, wheel and axle machinery and such other tools as are required.

A depressed track carried along the ends of the wheel storage tracks outside facilitates unloading and loading of wheels and axles.

The heating, lighting and service equipment is similar to that described for the main locomotive shop.

Pattern Shop and Pattern Storage.

Space for the pattern shop and pattern storage is provided in a separate building located adjacent to the foundry, a fire wall separating the pattern shop from the pattern storage.

The general construction of the building is the same as that of the other buildings—the roof of slow-burning mill construction. The structure is 162 ft. long by 31 ft. wide; is heated by the direct system and lighted with keyless socket marine type incandescent lamps.

Foundry.

The gray-iron foundry building is 203 ft. long by 80 ft. wide, constructed with two bays. The frame is of structural steel carried on concrete footings. The general construction is the same as that described for the other buildings except that the floor is of the usual clay type used in foundries and the roof over the cupola room is of corrugated asbestos.

The bay of higher cross-section is served over its entire length by a ten-ton high speed traveling electric crane. Jib cranes attached to building columns are provided. These cranes are so arranged that they may be removed from one location to another if desired, being handled by the traveling electric crane. In the side bay of lower cross-section space is provided for core making and shop molding floor.

The charging floor for the cupola is located in the center of the lower bay.

Heating is by the indirect fan system with underground tile and concrete hot-air ducts. For general illumination flaming arcs are used in the high bay and ordinary arcs in the low bay, with outlet boxes for extension lamp cords.

The location of this building alongside of and parallel with the traveling electric yard crane enables the unloading of scrap and pig-iron to be taken care of by the yard crane. This close proximity of the foundry to the yard crane also reduces to a minimum the handling of the castings from the foundry to storage, to the main shop or in loading for shipment.

Storehouse and Office Building.

This building is 252 ft. 6 in. long by 60 ft. wide. One end of the building for a length of forty feet is carried up three stories and contains offices on the second and third floors and a fire-proof vault. The remainder of the building, for storehouse purposes, is two stories high and contains electric elevator, platform scales, material bins and shelving.

The walls are constructed of hollow-tile blocks on concrete foundations. The framing is of heavy timbers, with roof sheathing of 2 by 4's surfaced on one side and one edge, and spiked together on edge. The foundations are carried up to bring the floor of the storeroom to car-door height.

The necessary toilet and lavatory facilities are provided. The offices are heated by direct radiation, the remainder of the building being heated by the indirect system. The lighting is by incandescent lamps. Fire protection is by automatic sprinklers.

The ground floor of the storehouse has a 1½ in. asphalt mastic wearing surface. The other floors throughout the building are of wood.

The window arrangement is such as to best accommodate the material bins and shelves without interference with good lighting.

The storehouse is located parallel with the main locomotive shop. The space between these two buildings is spanned by a high speed traveling crane which can be utilized to handle all heavy material to and from the cars from the storage space that is provided between the storehouse and the erecting shop. The use of this crane practically eliminates manual handling of heavy material and permits of handling numerous small parts in quantities when contained in suitable receptacles.

Material Platforms and Scrap Dock.

A material platform 90 ft. wide and about 350 ft. long abuts one end of the storehouse. This platform is also carried along either side of the storehouse, where it is 15 ft. wide. It is constructed of concrete retaining walls filled with earth and a top dressing of cinders covers the fill except alongside of storehouse, where plank covering is laid. The platform extends to and along the sides of the oil house.

Oil House.

For storing and distributing oil a separate building is provided convenient to, but located far enough away from the storehouse and other buildings to eliminate the fire risk. It is constructed with tile walls (plastered on the exterior) on concrete foundations, with a concrete basement at one end for the tanks which contain the oil for local distribution. The roof is of reinforced concrete slab, as is also the floor of the pump room over the basement. That part of the building used for storing oil in barrels has a cinder floor. The pump room is partitioned off with a brick wall carried up to make a fire wall.

Ten oil tanks with measuring pumps are installed and provision is made for conveniently emptying the oil from barrels into the tanks in the basement.

The oil house basement is heated by the direct system to the high temperature necessary to render the oil fluid during

extreme cold weather; the direct system being also used to heat the rest of the building. The lighting of the building is with keyless socket marine type incandescent lamps. Fire protection, including sprinklers, is installed.

Coach Repair and Paint Shop.

The building containing these departments is 362 ft. long by 146 ft. wide, having fifteen tracks on 24 ft. centers. It is constructed with hollow building tile carried on concrete foundation. Heavy timber posts support the roof, which is of slow burning mill construction. Otherwise the construction is the same as that described for the main shop building.

Space is provided along one side of the building for varnish room, upholstering, office, sub-store, paint storage, heating plant and air-brake repairs.

When necessity arises for increased shop capacity in this department it is proposed to obtain such increase by the erection of another shop on the opposite side of the transfer table.

Heating is by the indirect fan system with underground concrete and tile ducts. Lighting is by incandescent lamps. Compressed air, steam and water service, including fire protection and automatic sprinklers, are provided. Toilets, lavatories and conveniences for the men are also supplied in this shop.

Freight Car Repair Shop.

This building is 231 ft. wide by 303 ft. long and contains eight repair tracks spaced in pairs with industrial track between each pair of repair tracks. A tile wall partitions off the shop, 50 ft. wide along one side, which will contain the blacksmith forges, tools, heating plant, foreman's office, toilets and lavatories.

The building is of structural steel frame with tile walls, plastered on the outside, with saw-tooth roof construction. The general construction of the building otherwise is the same as that of the other shop buildings. An overhead trolley beam is provided to permit of handling timbers with a trolley into the shop.

Compressed air, steam and water service piping, and fire protection, including automatic sprinklers, are supplied. Heating is with the indirect fan system with underground concrete and tile ducts. Lighting is by 100-watt Tungsten lamps.

The location of this building alongside of the lumber yard permits of handling lumber so that it can be passed through into the shop without rehandling.

Planing Mill.

This building is 303 ft. long by 80 ft. wide and contains the woodworking machinery. The frame is of structural steel carried on concrete footings. The general construction of the building is the same as that of the other shop buildings. A track extends through the building longitudinally to permit of movement of material in at one end to the various machines and out through the opposite end with the minimum amount of handling. The building is located so as to be convenient to the passenger car shop and the freight car shop. The lumber yard is located back of and at one end of the planing mill.

Suitable piping has been provided for distributing compressed air and water. The fire protection system includes automatic sprinklers.

Provision is made for toilets, lavatories and metal lockers for the men employed in this department.

Heating is by the indirect fan system with galvanized iron heating ducts. Lighting is by mercury vapor lamps.

Boiler House.

This building contains sufficient space for 2,100-horsepower water-tube boilers that are required to provide steam for heating the shops and for other purposes for which steam is required throughout the shops. The building is constructed with brick walls carried on concrete foundations with steel roof trusses and supports for coal bunkers. The chimney is of reinforced concrete, 200 ft. high, with a minimum diameter of 9 ft.

Northwest View Showing Roof Arrangement with Reference to Lighting of Erecting and Machine Shops.

The overhead coal bunker for each boiler is divided by a reinforced concrete partition into two compartments to provide for storing and burning two kinds of coal. An overhead storage bin for ashes is provided, from which bin the cinders can be discharged by gravity into cars alongside of the building. A concrete dumping hopper is provided outside for dumping coal from cars. A pivot steel elevator raises and discharges the coal into the overhead bunker. A skip-bucket with electric hoist handles the ashes into the ash bin.

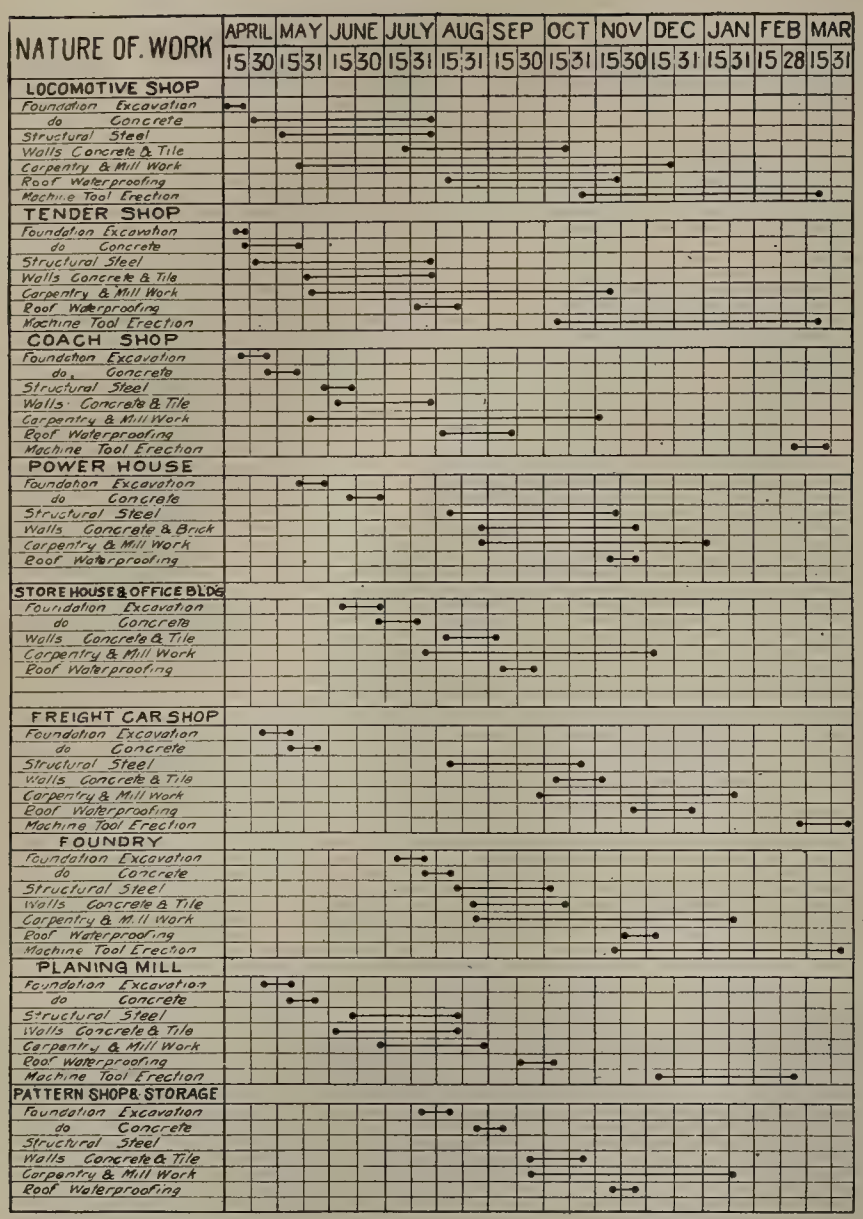
The boiler units are 350-horsepower rating and are set in three batteries of two each. Five of the boilers are equipped with chain grate stokers. The sixth boiler has the shaking grates to burn shavings and other planing mill refuse.

Space is also provided for three electrically-driven air compressors, each of a capacity of 1,500 cubic feet of free air per minute. Only two of these compressors are installed at this time.

Transformers and distributing panel are located in this building for transforming and distributing light and power current to the shop yard, freight car shop, planing mill and coach repair shop. There is no direct current apparatus in this station.

Provision has been made for two incoming 2,200-volt lines, one of 2,000 K. W. and the second of 1,000 K. W. capacity for breakdown service.

The steam required for the steam hammers and other shop purposes during the summer time can be supplied by one boiler. The boiler capacity provided will afford one spare boiler during the extreme weather conditions when the maximum steam demand occurs.



Progress Record of Calgary Shops Showing when Construction Was Started and Finished.

Yard Crane.

A yard crane runway, 1,260 feet long, extends from the west line of the locomotive shop and carries a 10-ton high-speed traveling electric crane with 80-foot span, serving the material yard and a portion of the storehouse platform and scrap dock. One of the storehouse tracks extends through under this crane, resulting in giving ample space for the storage of material alongside of the storehouse, foundry and locomotive shop. By this arrangement heavy material can be unloaded, stored and rehandled to the shop or loaded out again by the crane for shipment, practically elminating manual labor in the handling of all heavy material.

Miscellaneous Structures.

The transfer table for serving the coach shop is 75 ft. long, of 150 tons capacity, equipped with electric motor, with concrete transfer table pit 400 feet long, extending out far enough at either end of the building for providing entrance and egress at both ends.

The mess building is 269 ft. 6 in. long by 31 ft. 10 in. wide, of wooden frame construction, covered outside with sheathing, building paper and siding and sealed on the inside with metal sheathing. It has a concrete floor and contains a dining room and lunch room for the workmen and a dining room for the officials, together with kitchen and pantry. Sixty feet of the length of the building is carried up two stories to provide an apprentice school-room and quarters for the help. Heating is by the direct system and lighting with incandescent lamps.

There are also two small buildings located near the freight repair tracks for blacksmith shops and workmen's tools, and in one of them is a small toilet and office. Dry kiln, material bins, plate and iron racks, coal and coke sheds are also provided.

For obtaining water for shop purposes there have been put down two eight-inch wells equipped with electrically operated pumps. To supplement this supply and to provide a main source of supply for fire protection the City of Calgary has brought down into the shop site to a point midway the length of the main shop building on the west side a ten-inch cast iron water main. The shop service and fire lines are connected

Interior of Planing Mill, Calgary Shops.

onto this main and into a steel tank of 125,000 gallons capacity, which is erected on a 70-ft. steel tower, principally for use in connection with automatic sprinklers in the various buildings where these are installed. A complete fire protection system has been put in with hydrants distributed about the shop yard.

The sewage system in the shop yard may be divided into the sanitary and storm sewers. The City of Calgary is furnishing the main sanitary sewer, beginning at the east line of the freight car shop and extending to the eastern boundary of the shop property. All the sanitary sewage lines from the various buildings are connected into this sewer. Storm sewers are provided where necessary to carry off the roof water from the buildings where the roof construction is such that this cannot be discharged onto the ground.

The location of the shops is about four and one-half miles east of Calgary, practically on the open prairie and on the beginning of construction arrangements had to be made to house and board on the shop property a considerable quantity of labor. To this end, frame bunk houses were built with two tiers of bunks on each side of the building, eight bunks long, each house having a capacity of 32 men. Stoves were placed in the center aisle and benches along the sides of the lower tier of bunks. On the coming of summer and as the labor forces were increased some of the men were housed in standard 12x14 wall tents which accommodated four men each. A large mess room and kitchen and storeroom space was also fitted up with a capacity of feeding about 400 men at one time. Great care was exercised throughout the work in keeping the camp in a sanitary condition. This work was largely under the direction of doctors who visited the camp each day to take care of possible sickness and an arrangement was also made whereby those who were employed on the work voluntarily contributed a small amount from their wages for the services of these doctors. This amount also included hospital service when necessary. Due to this care there was very little sickness on the job.

As there were no accommodations for men with families near the shops, the railroad company put into temporary service a train to carry the men back and forth from Calgary and several hundred men went back and forth on this train each day. This arrangement helped the situation considerably, especially as the season advanced and all kinds of skilled and unskilled labor became more difficult to obtain. A standing order was placed through several labor agencies in Calgary to send men daily to the job. As the work neared completion the bunk houses and mess house previously mentioned were turned over to the railroad to take care of their own men who were at that time living in cars on the property. This, of course, released the cars and permitted their use at other points.

The progress schedule will show the prosecution of the work but it should be again pointed out that it was not possible to break ground until April 1, 1912, and by March 17, 1913, the locomotive shop was in full operation. When the magnitude of the work is considered as also its distance from the larger centers, it will be appreciated that a record for prompt performance has been established.

METHOD OF CUTTING KEY WAYS IN PISTON RODS.

There must be some one best way of performing standard operations such as this in all railway shops. As there seems at present to be such a variation of methods and the time taken varies all the way from forty-five minutes to three hours, I submit my method in the hope that if there is any quicker method in use that it will be forthcoming in a later issue of the *Railway Master Mechanic.*

I have seen the work performed on a special machine for this class of work which uses two cutters, and while a first-class job is done I consider it takes too long, and further I have yet to be convinced that such a perfect job is necessary, as the keys only require to fit on the one edge; that nearest the point or small end of the piston rod. The other end should be at least three-eighths of an inch clear of the key. Also the key should not fit on the sides. Therefore time spent in making the key way any better than it needs to be is unnecessarily wasted.

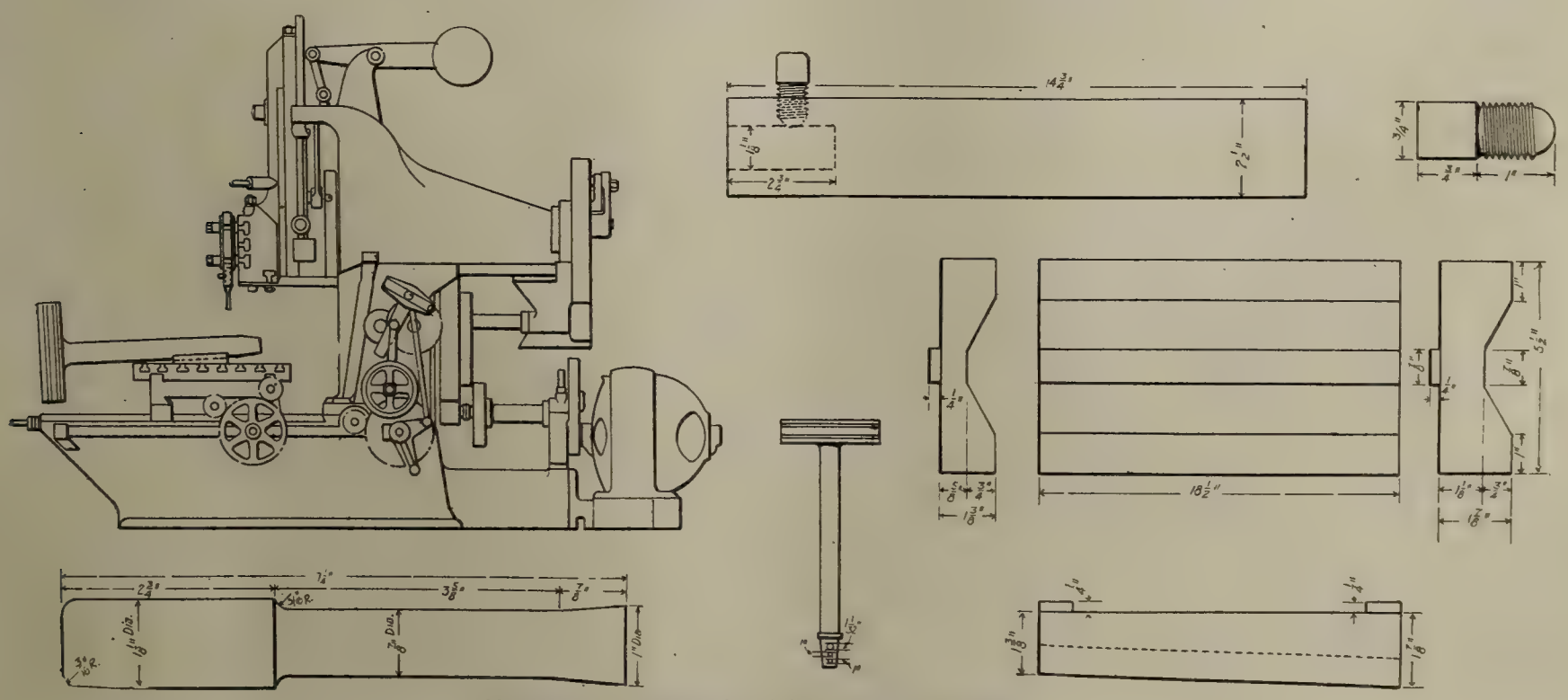
The method just described usually takes more than one hour, generally according to my observations one and a half hours, and as very little use can be found for this machine in the average railway repair shop on other work I do not consider it advisable to install one.

I have also seen this work accomplished on a milling machine with an end mill after having first had the holes drilled through. This also is a slow process and frequently results in broken milling cutters.

The worst method I have yet noticed and about the most used one is to just drill out as much as possible of the slots, then chip, broach and file them to fit at the bench. This is a very laborious and slow method indeed.

The one shown herewith is very satisfactory and the time taken is less than one hour, including the drilling and slotting.

The tools are made of high speed steel and turned to fit the holder shown. We find that by making the tools concave on the ends a better cut is obtained. This is not shown on the drawing. By turning these tools around in the holder when one cutting edge becomes dull a new edge is obtained. The jig of course is made the corresponding angle required. OBSERVER.



Method of Cutting Key Ways in Piston Rods.

THE COAL PILE.

By J. S. Sheafe, Engr. Tests, Illinois Central R. R.

Whether the old saying meant that the wood pile was valuable or that it was used as a screen to cover up future operations matters not. In either case it was considered worth while to keep an eye on it; now it is well worth while to watch the coal pile.

If railroad managements only realized the direct and possible economies sticking out of every coal chute, increased net earnings would follow. They have, perhaps, carefully read reports of their fuel agents and similar officers and have more carefully pigeonholed them. They have accepted, only partially, the facts and have allowed abuses to go on existing rather than to put an abrupt stop to them.

An average-sized railroad will burn $3,500,000 worth of coal per annum. This means $9,589 every day, and if 10 per cent of this could be saved it would net $958.90 per day. If it costs half of this, or 5 per cent, to accomplish the saving, the railroad is in $479.45 by spending the other $479.45 in doing the work.

This amount means $14,383.50 per month for fuel inspection and supervision. $1,000 per month is probably above the amount spent by the average railroad for this important work, or 6.9 per cent of the 5 per cent or 0.34 per cent of the whole. Rather a small amount to spend for watching over waste and excesses of careless mines and employes.

Coal will become more valuable as time passes, if for no other reason than increased wages. In 1850 6,266,233 tons of coal were produced in the United States. In 1910 371,288,123 tons were produced, an increase of over 5,800 per cent.

The United States is supposed to have 194,000 square miles of coal lands, and to have enough to last centuries. We used to think that way about timber, however.

Coal should be watched over from the moment it is turned over to a railroad company. It should be placed in clean cars. Gravel, cinders, dirt and refuse of all kinds will be found in cars on mine tracks, if the matter has not been taken up and followed up. In contracting for coal, one idea should receive the greatest consideration, namely: what the coal will do on a locomotive. The sample is obtained from the face of the seam by the fuel inspector, the analysis is made in the laboratory and the traveling engineer is then able to advise what coals on his division are good and what are bad. The idea of traffic, or of policy, should be subordinated to locomotive performance in every possible case.

If good contracts are made the rest is much easier. If mines are known to take advantage of the absence of inspector, or if they fail to live up to their contracts, they should be eliminated forthwith. After accepting coal up to contract, and in clean cars, the company's interest in such coal begins.

Some citizens along the right of way expect to receive their coal gratis from the railroad, and they do, whether by pilfering at night or by jumping on a moving train, unloading large lumps, getting off and picking them up. This, together with the natural shrinkage and loss, through holes in bottom or loose hoppers, means that the car being billed at 50 tons may weigh 46 tons when dumped. If a railroad accepts mine weights it is taking a chance of paying too much. It should run cars over its own scales, weighing each car individually, i. e., at rest and uncoupled, and the contract should call for settlement on such basis.

If 50 tons are billed, and this amount is found correct on its own scales, 50 tons are paid for. If only 46 tons get into coal chute, 50 tons, or billed weight, should be distributed against engines. taking coal. The loss from pilfering and shrinkage is an item of cost just as much as is the haul charge. Any performance sheet not so showing this coal charge is misleading, as there is a difference between amount paid for and amount burned, of which there is no account.

Cars on arrival should be inspected by the coal chute foreman, who should have information as to what the contracts are for various mines. If the car is thought by him to contain coal below grade, he should set it aside and report the circumstances by wire, so that a joint inspection can be made. All company coal being carded at mines, he knows where the questionable coal is from. There should be no case of using coal and complaining of it afterwards.

Each chute should be in charge of an intelligent foreman, working or supervising. By this means alone will there be a coal balance each month. He should give an engine just what coal is necessary to fill the tank, as by continually estimating the quantity required, he becomes very skilled in hitting the correct amount.

He should collect a ticket corresponding to the amount of coal delivered. In this way engineers are prevented from calling for six tons to fill a four-ton space, with the consequent overflowing of the tender, and loss.

As to the design of coal chutes, much can be said. Most railroads, in making firemen's schedules, promise coal to be put on tenders in firing size, which means no lumps over 6 inches. As the mine furnishes coal in larger lumps, it must be broken at the coal chute. There are two ways of doing this; first, by a mechanical crusher, and, second, by the use of breaker bars.

The former method breaks the lumps, but is somewhat severe, as it increases the percentage of slack. The latter has more to recommend it, as the coal is dumped directly onto the bars and knocked through with coal picks. Cracking a lump of coal with a pick does not make slack. A crusher does.

A chute designed for breaker bars should have more width than is necessary in one where the coal is dumped into the open hopper and elevated to the crusher. This allows more working space for the men who knock coal through the bars.

Where a mechanical crusher is used there is usually a system of grating on which the coal is dumped, the lumps, under a certain size, and the screenings, falling through to a plate which is supposed to deliver it to the center, or apex, of the chute floor. The momentum of the lumps carry them beyond the center and the slack drifts along slowly and falls to the near side.

With this arrangement engines on one side of the chute will get clean coal and on the other excessive slack. Such a condition can be improved by placing a plate over the grating and delivering both lump and fine coal through the crusher. Of course, the fine coal, and small lumps, are not injured by the crusher.

Extreme care should be taken that the delivery of coal should be directly over the apex, or center, of the chute floor. This makes an equal distribution of fine and coarse coal on both sides of the chute.

In many chutes the slope of the floor is too little for the force of gravity to act on the slack. The lumps keep on rolling to the bottom and the slack piles up. Finally this is so excessive that the pile breaks and several engines, in succession, receive nothing but slack. Coal should reach the tender just as it leaves the car, with the exception that the large lumps are broken.

Slack coal, if piled on a horizontal plane, will remain at complete rest. On the other hand, it cannot cling to a vertical plane. It follows that between a horizontal and vertical plane there is a critical angle at which slack coal is acted upon by gravity, sufficient to overcome the friction between the coal itself and the chute floor, and at which it is impossible for it to remain at rest. This will be found to be from 55 to 60 degrees. All chute floors should be built at this angle and thus enable the slack to travel along with the lump. Fewer engine failures result.

In chutes where slack piles up, firemen have become educated to the fact that, with the doors which open just as the trough can accommodate the coal delivered, they get the top coal, or lump, if the trough is not let down as far as it will go. This means that the bottom coal, being slack, is left in the chute and some one else will get it. The dropping of the trough should be one operation, and the opening of the door, or slide, should be

another. By this method the coal must be taken from the chute directly as it comes.

Accumulated slack means the necessity for cleaning periodically. If mine run is purchased at $1.07½ at mine (Kentucky field) and slack piles up in the chute the loss is extreme even in the coal itself and disregarding the labor of handling, etc.

Screenings (Kentucky field) are worth 32½c, but the slack is much less valuable as screenings, as are any pieces that will pass through holes 1¼" in diameter.

This means more than 75c per ton, and if 400 tons per month are removed, the lowest net loss is $300, and all for the want of sufficient pitch to keep the slack mixed in, and traveling, with the lumps.

It is true that this chute refuse coal can be used at pumping stations, but why not buy better coal (screenings) to start with and at a much lower price?

Properly prepared coal on locomotive tenders can be had. Infrequency of coal failures and increase of efficiency and economy will surely follow.

While the waste and extravagance, up to this point, is marked, there is yet much which requires attention.

An engine is "dead" in the roundhouse. The flue borer marks off his work, called for, after puttering around the flue sheet. It is not generally known how little real cleaning flues receive. A thorough following up of this class of work by traveling engineers and foremen will convince them that they have for years neglected one of the most important parts of keeping their engines in shape. It is not altogether their fault except that they have perhaps placed too much confidence in human nature and have taken the line through "bore out flues" to mean that such work was done.

If they feel that this condition does not exist they can easily learn, whether their man is going clear through the cinders, by following him up.

An engine cannot steam if its flue sheet is a baffle plate.

Many a nozzle tip could be opened up if the flues were kept open.

If an engine is ordered the fire builder gets busy. His idea usually is to get the engine hot in the shortest possible time and out of his hands. The hostler finishes up what the fire builder has overlooked in the matter of steam pressure.

They both want the engine full of water and popping off whether fifteen minutes or four hours before leaving time. Think of the waste, the noise, and the dead fire when most needed!

Excepting in emergency cases, an engine should be fired up with the blower on only enough to carry the smoke up through the stack.

If the water just shows up in the glass, when cold, it will be ample in getting engine out when hot enough to move.

An engine should be allowed to gradually get steam pressure, without the blower. Thus, when delivered to outgoing track, there is a margin to work on. As steam pressure will quickly rise, there being a good healthy fire in the firebox, the injector can be put on and cut down so as to enable the engineer to fill the boiler, and the fireman to build up his fire without the engine popping.

There is sufficient time, after coupling up, while the inspectors are looking over the train and testing the air.

An engine popping off prevents inspectors from locating air leaks. It keeps the fireman from getting a good body of fire and means hard work and waste of fuel in trying to bring the fire into shape while pulling out.

But still, at most roundhouses, the same old conditions exist, engines are full of water, popping off, the fire thin and mostly ashes and from one to three hours until leaving time.

What is the cost?

If the full value of the heat units possible to use are converted into steam, the locomotive is still an extravagance. Reduce this and the loss is enormous. Each engine should be carefully drafted until the fire plays around the door when it is open. The baffle plate on the door should be white and not covered with soot. The nozzle tip should be experimented with to see if it can be made larger, even if a split must be used.

Many thousand tips are running today so gummed up that the efficiency of any locomotive carrying such is greatly interfered with.

No set rules can be given for drafting locomotives, for the same reason that hat trimmers are necessary in millinery shops to experiment until they arrive at something which will give satisfaction, and it is noticeable that each hat is different.

Having seen that the locomotive is in shape, and that the coal is good, further waste must be found in the way engine crews do their work.

These men are like all the rest of the industrial world. They are responsive to appreciation of good honest effort and are prompted to a spirit of superiority in work and record exactly as are men in other lines.

They feel at times, as do others, that there is not much use in trying, but they are open to conviction always. They should be shown figures of fuel costs and have their interest aroused in the work of economy. They should be taught how to avoid waste of company fuel, not by books, because not one engine man in ten is a student, but by personal contact with one who is most competent to demonstrate. This one will most always be the traveling engineer who has completely informed himself as to what it all means.

As coal waste may be caused quite as much by the engineer as by the fireman the necessity for checking up his work is apparent.

The ways in which coal is wasted on a locomotive have been discussed many times, and generally consist of acts on the part of engine crews which indicate indifference to say the least.

However, even this may be easily overcome as soon as every one understands that the management expects an exact accounting from those having to do with fuel.

If the engine crew understands the extreme loss following imperfect combustion, that the fire door should be closed between each scoop full of coal, that the injector should be cut down just so as to supply the boiler, that a closed throttle means wire drawing, that a fire should be put in just before starting, that a company should not pay the bill following personal quarrels in the cab, that effort and loyalty will put more money into their pockets, that a fire should not be put in just as engine is shut off, etc., etc.; it is hard to realize that they will wantonly do these things.

They will, however, if left to themselves, except in rare cases. They will not if their work is watched and commented on.

Some sort of penalty should be laid on the fireman who brings in an engine with a full firebox unless he has some good excuse for so doing, such as disconnected grates. He, in not keeping down the thickness of the fire, has shut off the supply of air necessary for complete combustion and burned more coal than he should.

It is possible to put in more coal when a locomotive is standing, before the fire is covered, than when working steam.

A fireman, leaving an engine, needs only to throw in a very small amount of coal, say three or four scoops, to keep it until the fire knockers get hold of it.

The only practical place for this coal is up under the flue sheet in a small bank.

The value of coal annually lost into the cinder pit would purchase many new locomotives, and firemen should be looked to, to save this loss.

Before the fire is knocked, full air pressure should be pumped to prevent pumping air while the engine is being put into the house. The blower should be cracked just enough to lift the dust and heat while the fire is being cleaned.

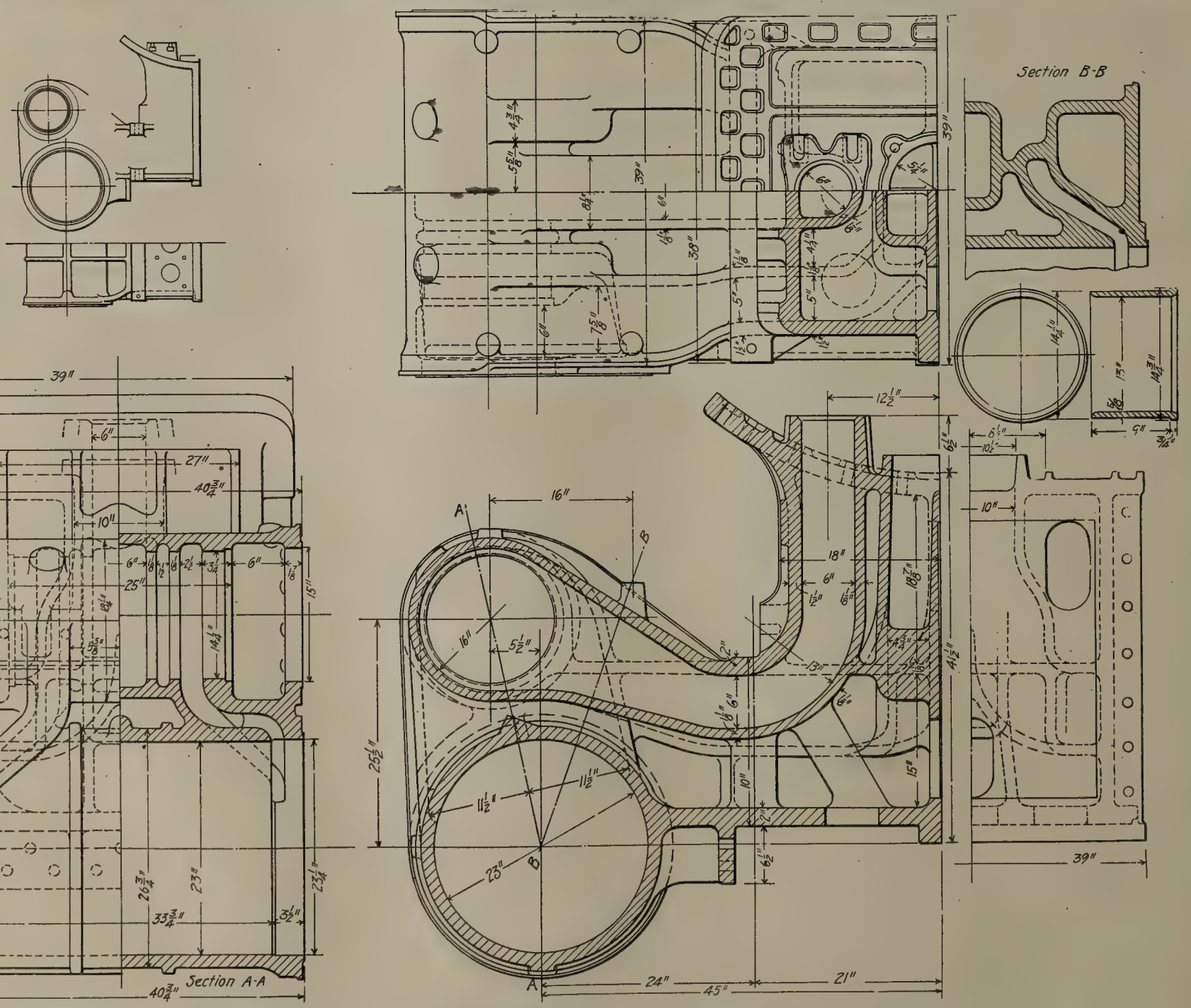
CONSOLIDATION LOCOMOTIVES, PHILADELPHIA & READING RY.

The Philadelphia & Reading Ry. has recently turned out at its Reading shops an order of twenty new consolidation locomotives, known as class I-8-b. These locomotives are similar to the class I-8-a locomotives which were built some eight years ago, except that the new engines have been equipped with Walschaert valve gear and piston valves. The Walschaert gear was adopted in place of the Stephenson, on account of the better inspection and lubrication afforded, and also as it gives less trouble in service. The new engines are medium weight consolidations, and are used for general freight service. This is the largest type of engine in service on the Philadelphia & Reading, with the exception of one Mikado, built last year, which is considerably heavier.

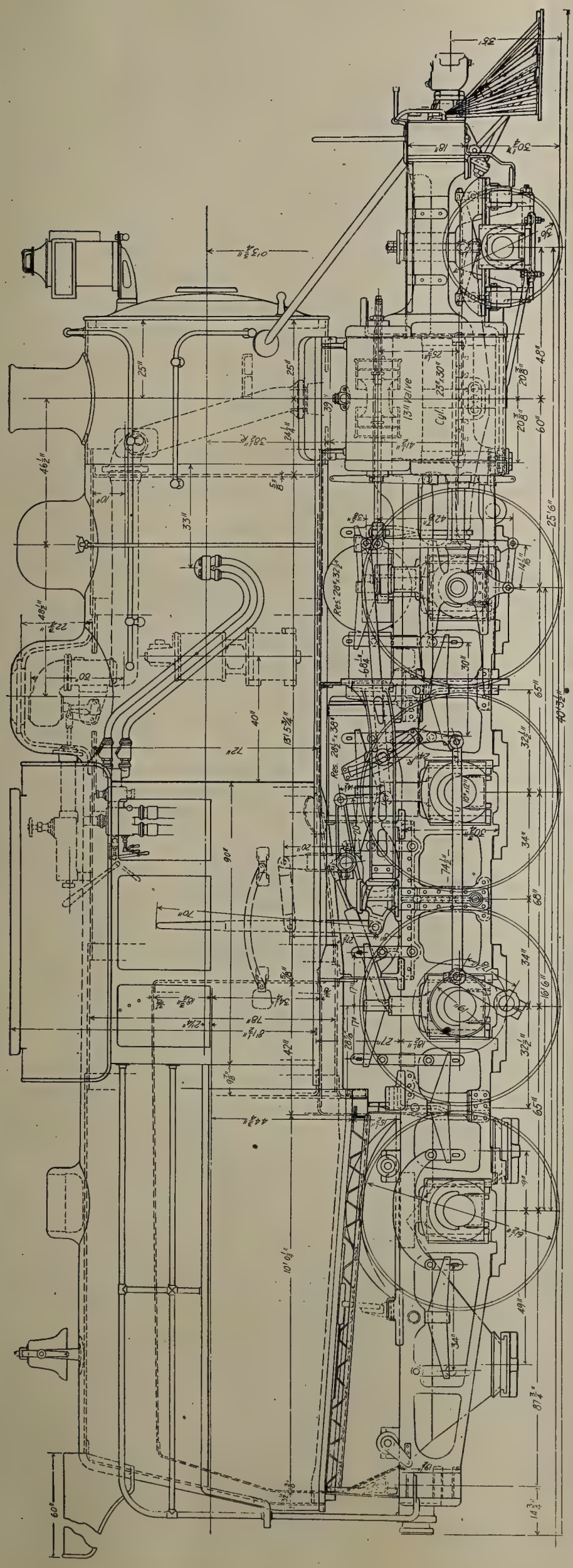
The boiler is of the straight-top type, carrying 210 pounds pressure, and equipped with two three-inch Crosby muffled safety valves. The staying is radial, Tate bolts being used in the throat and at the corners of the firebox. The engines are equipped with Hanlon sanders. The firebox is of the Wootten type. The cylinders are 23x30 inch with 13-inch piston valves, and are lubricated with Detroit sight feed lubricators. The tender has a capacity of 7,000 gallons of water, 12.8 tons of coal, and its weight, light, is 65,500 pounds. Its frames are composed of 12-inch channels.

The accompanying illustrations show views of various sec-

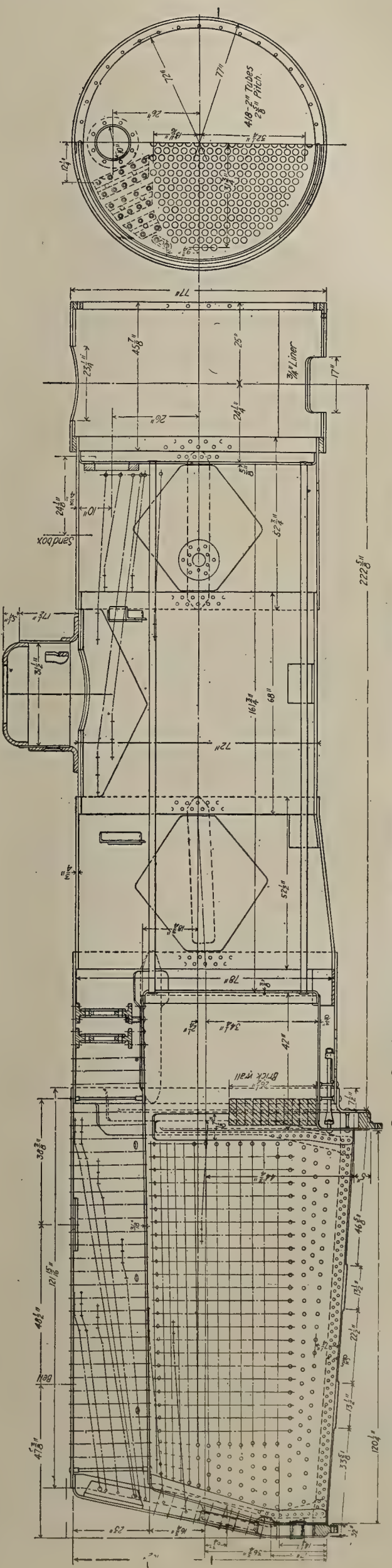
Consolidation Locomotive Built at the Philadelphia & Reading Shops.



Sections of Cylinder and Saddle, Philadelphia & Readin g Consolidation Locomotive.



Consolidation Locomotive, Philadelphia & Reading Ry.



Cross Section of Boiler Shell, Philadelphia & Reading Consolidation Locomotive.

tions of the boiler shell, frames, cylinder and saddle casting and elevation. Following is a comparison between the old and new locomotives of this class:

	Old Class I-8-a	New Class I-8-b
Tractive force	44,081	46,060
Weight	227,800	239,000
Heating surface	3,195.5	3,195.5
Average weight for driving axle	51,300	53,875
Valve gear	Stephenson	Walschaert

LOCOMOTIVE FUEL ECONOMY.*

By Robt. Collett, Superintendent of Locomotive Fuel Service, Frisco Lines.

Statistics are not generally interesting, but it may be of interest to those who have not given the subject particular thought or study to know that for the year ending 1912 there were 236,444 miles of railroads in the United States; the cost of fuel for operating trains over them $230,555,544.00, or 11.85% of the total operating cost, 8.22% of the gross earnings, a cost of about $4,000.00 per year for each locomotive in service. In the past two years there has been considerable increase in the unit cost of fuel and this has further increased the ratio of fuel expense to the gross earnings.

The fuel bill on the 17 largest railroads entering St. Louis and East St. Louis for the fiscal year ending June 30, 1912, was $51,432,545.00. We can readily understand, therefore, that railroad managers are very much interested in keeping the cost to the lowest possible figure; and when purchasing new locomotives or overhauling engines in service, consideration is given to equipping them for the greatest economy in use of fuel.

I shall confine my remarks principally, however, to methods used aside from special appliances. Appliances of whatever nature, unless properly looked after, do not produce results, and it, therefore, resolves itself largely into the matter of the human element.

A crew should not be sent out in charge of a $20,000.00 locomotive with $30.00 or $40.00 worth of coal in the tank, and access to that much more if required on the trip, without feeling a personal responsibility in the care of the engine and supplies, and there should be some way of determining whether or not proper efficiency is obtained.

At the close of the year 1910, a plan was originated by W. C. Nixon, vice-president in charge of operation of the Frisco Lines, to look into the matter of locomotive fuel economy. Briefly, the plan was to undertake to find out what we were doing in the use of the locomotive fuel and what we might reasonably expect to do and how to do it. Some of the items given special emphasis by Mr. Nixon were:

Item 1. Waste of fuel by reason of engines delayed on road.

Item 2. Engines kept under steam unnecessarily at roundhouse.

Item 3. Improper handling of engines.

Item 4. Excessive use of fuel by firemen.

Item 5. Engines not in good condition.

Item 6. Fuel not up to contract specifications.

Item 7. Shortage of coal reaching pockets.

Item 8. Fuel used for other purposes and improperly charged to engine use.

Item 9. Performance sheet to be made by engines, so that the result of each trip would be shown in a statement by days in order that an abnormal amount of fuel used on any one trip or day could be determined.

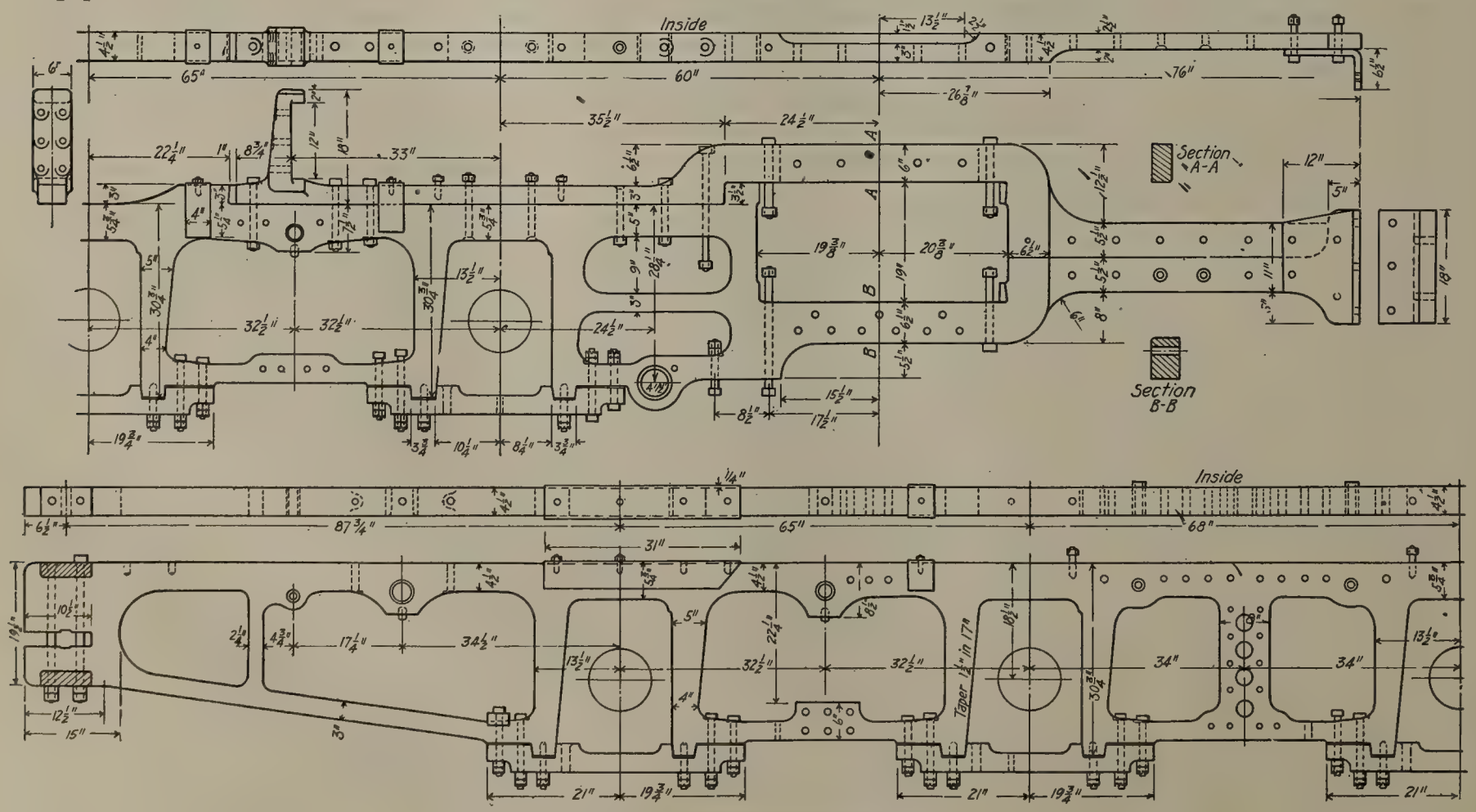
Item 10. Any other matters that may require attention.

This plan was put into effect the latter part of December, 1910, and at first confined to one division, and by the close of the year 1911 on all divisions. A record is kept by charging the amount of fuel used by each engine in moving over the division each single trip against the gross ton miles in freight service, and passenger car miles in passenger service, for that particular trip, the work being entirely independent of the fuel department or mechanical department. The result at the close of the year 1911 showed a very gratifying saving in all classes of service.

The result of the effort in the direction of fuel economy on the St. Louis & San Francisco in passenger and freight service for the calendar years 1911 and 1912, compared with 1910, is shown in the attached statement.

This statement is predicated on the pounds of fuel used per 1,000 gross ton miles in freight service and pounds per passenger car mile in passenger service—the accumulative saving fig-

* A paper delivered before the St. Louis Railway Club.

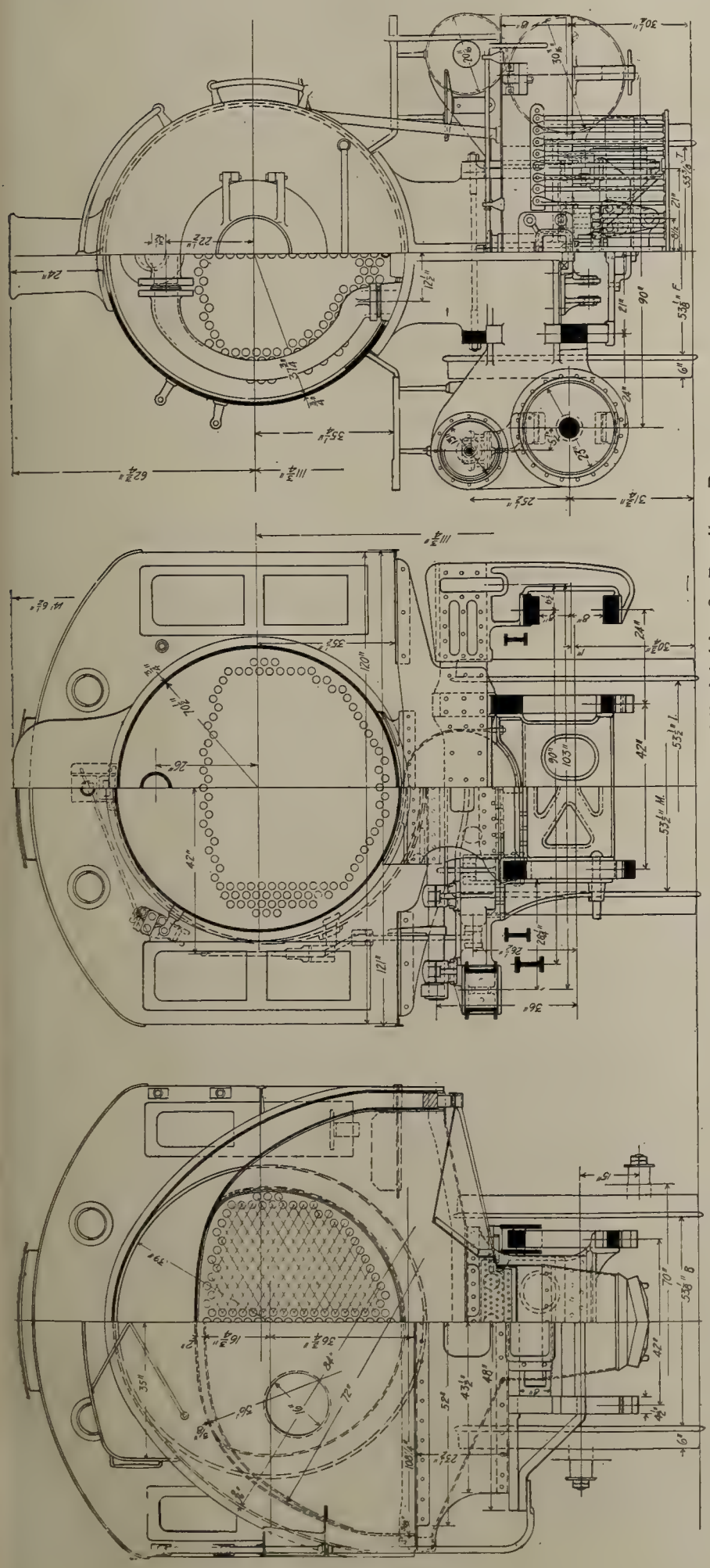


Frames for Philadelphia & Reading Consolidation Locomotive.

ured on cost of fuel exclusive of cost of transporting it over our own lines; neither does it include expense of handling, and does not include waste and work service. This statement was gotten out principally to show the enginemen and all others concerned the progress that was being made.

Necessarily any saving in the volume of fuel used will reflect a further decrease in operating costs incident to the smaller volume of company material, which in this case is cars of company coal or oil, that must be moved without revenue return.

You will note by reference to the graphic chart that we were not quite able to maintain through 1912 the good record established in 1911, although owing to the larger volume of business handled in 1912 as against 1910 and 1911 the saving over 1910



Sections of Consolidation Locomotive, Philadelphia & Reading Ry.

was $262,000 as against $260,599 in 1911 over 1910. The reasons for this increase in 1912 are familiar to all of you who are engaged in the operation of railroads—the very severe winter and its effect on motive power and road bed, the Mississippi Valley floods in the spring and suspension of the mines with necessity for storing coal on our line at least served to make 1912 scarcely a comparative year with 1911.

In January, February and March, 1912, the Mississippi Valley in particular experienced several severe snow blockades. How this affected the operation of trains is evidenced to some extent by the double-head mileage necessary to keep passenger trains running. In the three months mentioned the St. L. & S. F. ran 70,401 miles of double-headed passenger trains as compared with 19,129 miles in the same three months of 1911, an increase of 51,272 miles.

It is not possible to state in dollars and cents what these weather stresses cost. Even if all direct costs were ascertained, the collateral costs, running into every branch of the service, could only be conjectured. There can be no question but that they were heavy.

The theory of the Frisco locomotive service is to get away from such report of the individual crews, for the reason that it is believed such report frequently results in sharp practice and may not reflect true conditions, whereas, if a report for engines is made and an engine is not in proper condition, it remains for the mechanical department to correct the defects; if due to improper operation on the part of the crew, it is for the division officers to see that they are instructed.

Test trips were made by riding engines just as they were turned out for service, to determine the actual amount of fuel used, and although an engine might steam well, if it burned an unnecessary amount of fuel, the cause was investigated. The following are a few of the trips made on two different divisions. The first trips were made just after the fuel performance sheet was started. The second series of tests shown were on oil-burning engines in a bad water district and are given to show what was accomplished when specialization was attempted. Referring to one of the trips in detail: You will note that engine 1288 consumed 345 pounds of coal per 1,000 ton miles. This engine did not fail on previous trips and was not reported as "not steaming." It later developed that the engine handled a light train the previous round trip and was not steaming freely. Investigation after making the test trip developed that a few of the superheater tubes were partially choked and steam pipes leaking. Another thing responsible for the heavy consumption per thousand gross ton miles is that on account of the engine not steaming, a few cars were set out and train did not fill out at the customary filling station.

Engine 1292 was steaming well, but was not handled or fired as economically as engine 1287 and burned one-half ton more coal, with considerably lighter train than engine 1287, which engine showed a saving over the 1292 of 23%, and 55% over engine 1288.

Engine 1283 on March 31 did not steam freely. Fire was forced in early part of trip and became badly clinkered, investigation disclosing superheater tubes partially choked, and proper combustion, of course, was not obtained on account of the bad condition of the fire. The same crew was on this engine on trip of April 6 with same weight of train, consuming 8 tons of coal or 123 pounds per 1,000 gross ton miles, a saving of 23% over previous trip.

With reference to the second series of tests shown: The benefit derived from specializing is well indicated in these performances, which are taken from the daily fuel performance records. The first trips were made without supervision, the second trips were made with supervision, when we were attempting to see what could be done by way of running water tanks and also in the use of fuel.

The figures were taken from the daily performance sheet and are the fuel foreman's charges, who was not aware that test trips were being made. However, in the last recorded trips,

the fuel charges tally with the records kept on the trip, except that the fuel foreman's figures include the terminal consumption, which is also included in all tests shown, both coal and oil:

First Series.

Date	Engine No.	Ave. Wt. of Train	Tons Coal	Lbs. Coal per 1000 Ton Mile
2-28	1288 St. Louis to Newburg	696	14	345
3- 3	1292 St. Louis to Newburg	968	11	198
3-29	1287 St. Louis to Newburg	1157	10½	155
3-31	1283 Springfield to Newburg	1118	10½	160
4- 6	1283 Springfield to Newburg	1118	8	123

Second Series.

Date	Engine No.	Train No.	Gallons Oil	Gals. Oil per Car Mile	Car Miles
2- 1	469	102	2104	1.67	1265
2- 1	479	104	2240	1.30	1710
2- 1	480	103	2283	1.26	1809
2- 1	471	101	1706	1.35	1265
1-28	480	104	1791	.90	1612
1-29	480	103	1639	.91	1489
1-31	480	104	1960	1.08	1815
1-18	476	101	1251	1.01	1265

These trips will show the necessity for establishing standards of efficiency. An engine may show a very good performance from a train handling standpoint and still be making a very poor fuel performance. A great many tests have been made on every division, after having gone over the engines to see that all of the detail that would affect the fuel performance was as nearly correct as possible, such as condition of valves, cylinder packing, air admission through grate and ash pan, size of exhaust nozzle, size of injectors—in fact, every feature that would improve the performance of the engine. Standards of fuel consumption have thus been established, and standards for draft arrangements, for each class of engines decided upon as being the most practical for the various operating conditions under which the engines work. The average performance of the engines in service will exceed the test figures, but the test figures show what the locomotive is capable of doing and furnishes a standard to work to.

I will now take up the various items previously outlined:

Item 1. "Waste of fuel by reason of unnecessary delay on line of road." The fact that all concerned know that the management is closely observing the fuel cost, results in train and enginemen calling attention to delays, and individual cases are followed up to prevent a recurrence.

Item 2. "Engines kept under steam unnecessary length of time at roundhouse." Lack of facilities will sometimes cause a waste of fuel in this respect. However, there is apt to be a tendency to put the burden of responsibility on the roundhouse foreman, requiring him to keep engines ready at all times. This was handled by establishing a rule that the transportation department will furnish the mechanical department three hours' notice of when engine will be required for service and as nearly as practical this rule is observed.

A report is made showing how much fuel is burned at each terminal by engines standing under steam for more than three hours, and a statement of the cost is submitted to each division superintendent at the close of the month. On short divisions, in passenger service, the amount of fuel consumed at terminal may easily equal 20% of the entire fuel used by the locomotives. On a number of divisions the passenger engines are now run over two freight divisions. At Newburg, an intermediate freight terminal located between Springfield and St. Louis, fires are not cleaned on passenger engines; we simply clean the ash pan and bank the fire, engine taking the next passenger train forward.

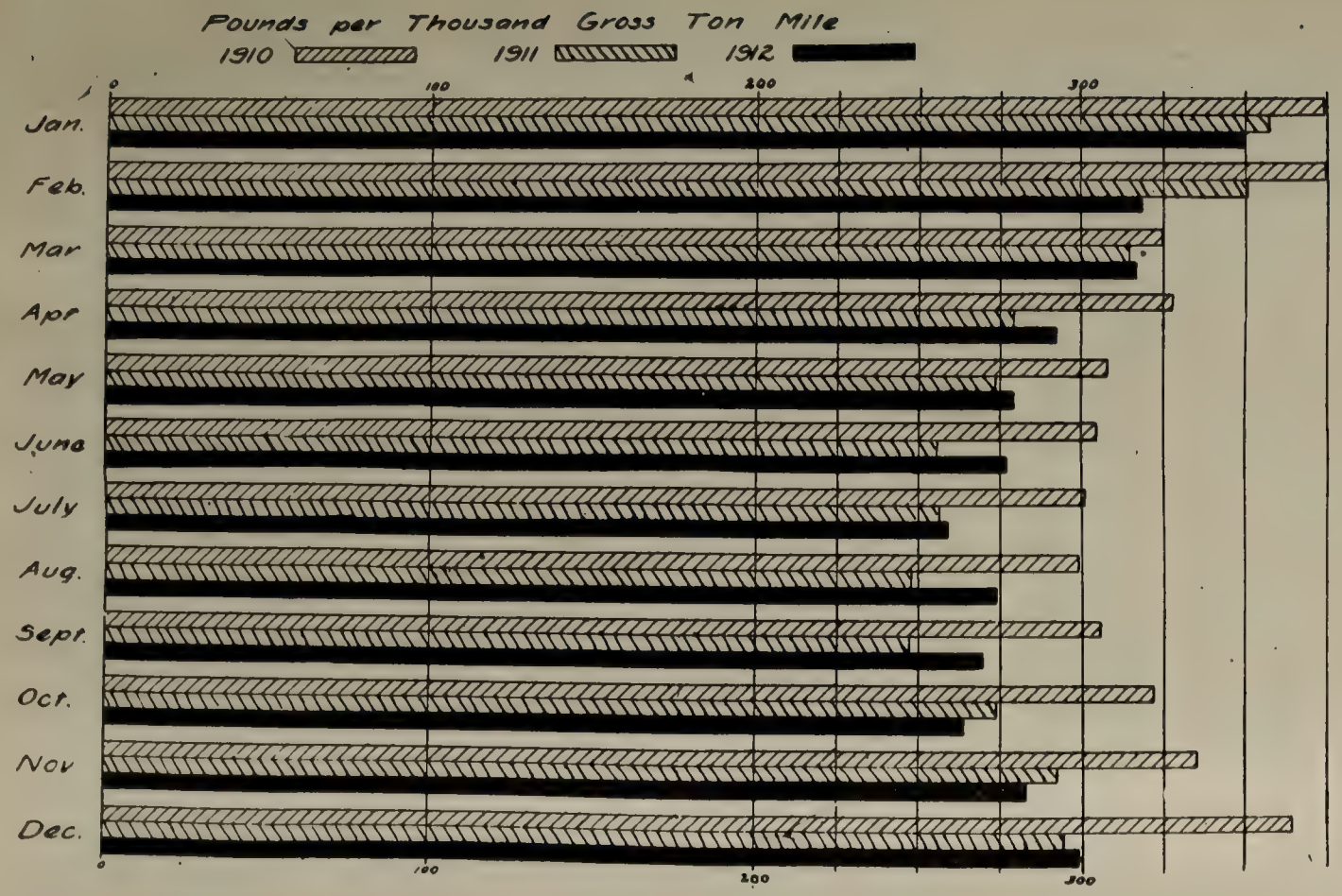
Items 3 and 4. "Excessive use of fuel by fireman and improper handling of engines." Proper results in the management of engines can only be obtained by first-class team work on the part of engineers and firemen.

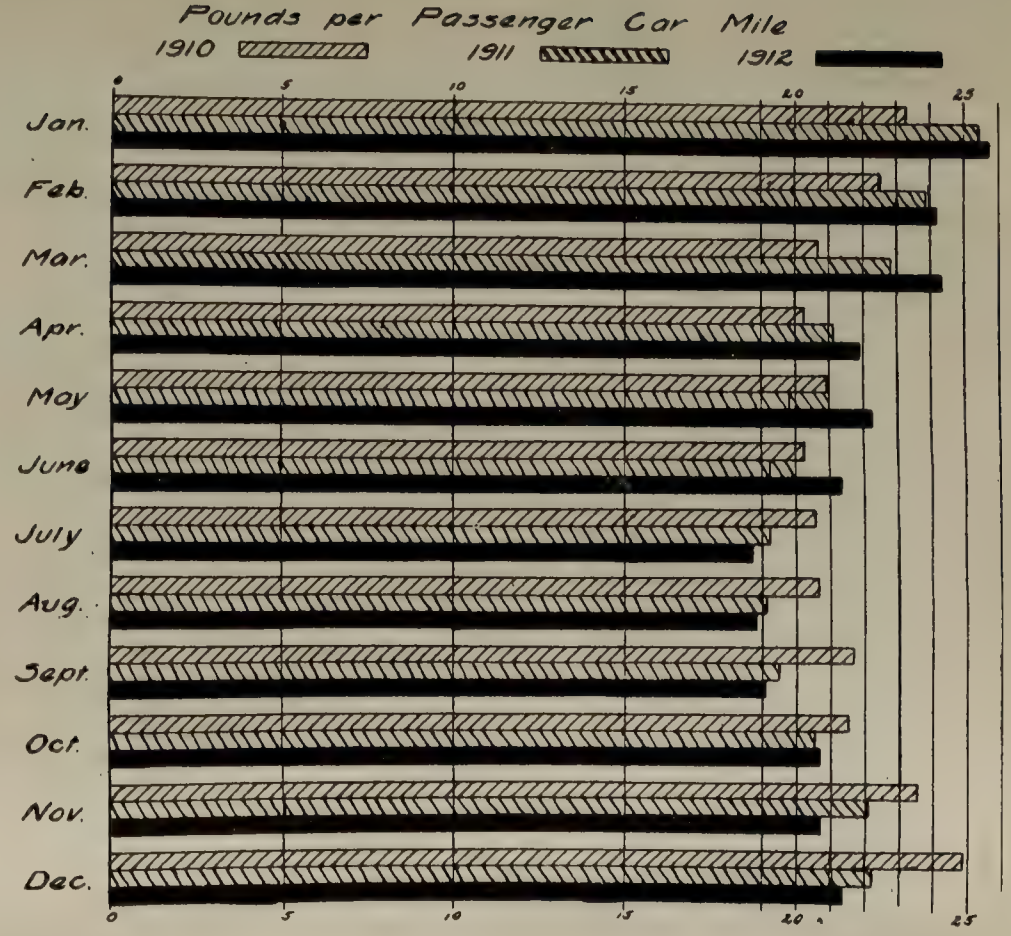
Before commenting on the work of the crew, I wish to say something about the man who has supervision over the crews. The title varies on different roads. It may be that of traveling engineer, road foreman of equipment, or supervisor of locomotive operation; with us it is assistant superintendent locomotive fuel service. This man has been selected for the position because he is a skillful engineman. He derives benefit from observing the work of all the crews and should know the best methods of handling and firing the different classes of engines, and should be able to impart this information to others, in such a way as to not give offense. He should possess a good disposition and at least two suits of overclothes, and if he is to obtain proper results in fuel economy he must have time to get out on the line with the crews. It is, of course, necessary to spend some time in the terminals, but his time should not be so taken up with other duties that he will not have ample time to follow the work of the crews on his division and also note the result of changes that have been made in the locomotive or appliances that have been put on, which are intended to improve the performance of the engine. The assistant superintendent of locomotive fuel service, who formerly held the title of road foreman of equipment, is in charge of the fuel economy work and is a part of the superintendent's staff. He is entirely independent of the fuel department or mechanical department, although, of course, his work is almost entirely in connection with the work of these departments. He watches the tonnage rating, to see that the engines get the most uniform loading possible, the maintenance of draft appliances found by tests to be the most efficient and economical, conducts all of the progressive examinations of firemen and assists the master mechanic in looking after the general care and operation of the engine by the engine crew.

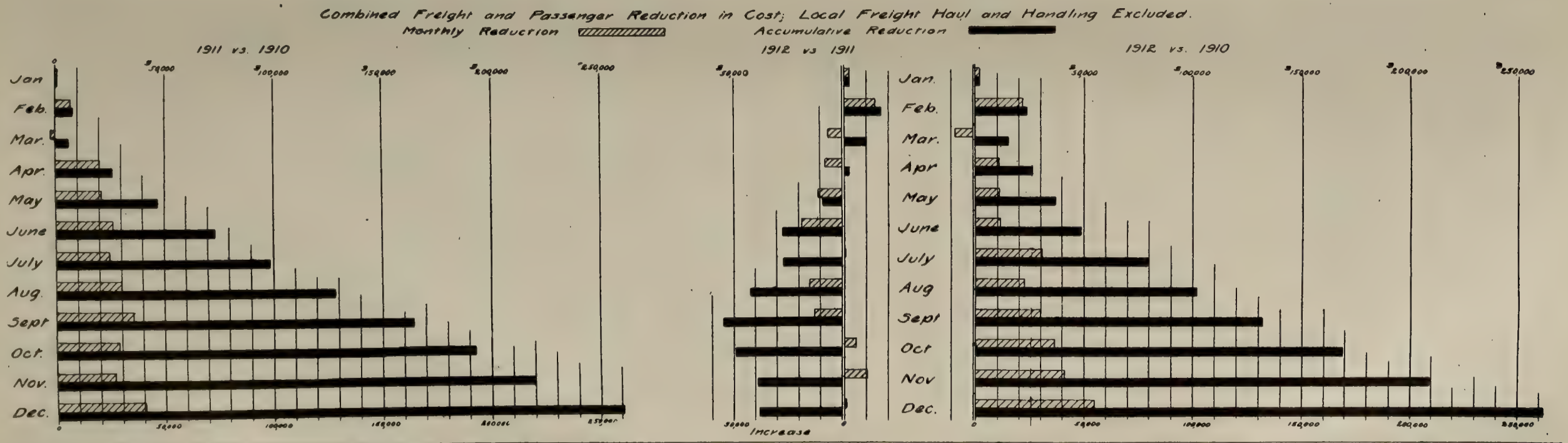
In the management of the engine there are not a dozen different correct ways to run and fire it. There is one best way to handle each class of engine, and he should know that way and let the others know it and ride with the crews often enough to know that they are doing their work in the proper manner.

Item 3. The engineer who makes the best fuel performance pays particular attention to a number of things. He knows what the condition of the fire is when he pulls away from the terminal and handles engine accordingly. He does not slip the drivers if it can be avoided, or tear holes in the fire. He opens the cylinder cocks as soon as circumstances admit and relieves the condensation, avoiding damage to pistons or cylinders or washing lubricants off the cylinder walls and valve seats. He starts the lubricator early enough to have the cylinders and valves well oiled before starting train and feeds both sides alike and regularly. He does not change reverse lever from full stroke to cut-off in one or two movements, but shortens the cut-off gradually as the speed increases and handles both the reverse lever and throttle so that, especially on slide valve engines, steam chest pressure does not back up into the oil pipes and retard lubrication. He works steam as expansively as consistent with good lubrication, schedule and general condition of valve gear, and this, without particular reference to the perpendicular position or angle of reverse lever. The injector is handled so as to not over-supply the water to the boiler requiring that the injector be shut off on account of too much water, nor does he allow the fireman to do so when pumping the engine. He understands the language of the locomotive and can feel its pulse without the necessity of a certain amount of noise at the stack, provided the engine will do its work without such noise. The running time is used between stations and the movement kept as continuous as possible. The result of his observations and opinions are responsible for the engines having been equipped with the present modern type of quadrant and reverse lever and throttle, as well as other devices that will permit of the engine being operated skillfully, and he utilizes them to the best possible advantage and at the completion of his trip reports the items that are needed to be done to maintain or improve the engine's efficiency. A careful crew, working together, can do a great deal to establish a proper fuel performance, more than all the devices known.

Item 4. "The matter of the firemen's duties." The first thing, of course, is to start firemen out right when employing







Charts Showing Comparative Consumption of Coal on Frisco Lines During 1910, 1911 and 1912.

PASSENGER

Month	Pounds Per Passenger Car Mile 1910	1911	1912	Per Cent Decrease 1911 vs 1910	1912 vs 1911	1912 vs 1910	Cost of Passenger Fuel 1911	1912	Reduced Cost 1911 vs 1910	1912 vs 1911	1912 vs 1910	Accumulative Reduction 1911 vs 1910	1912 vs 1911	1912 vs 1910	Pounds Per 1000 Gross Ton Miles 1910	1911	1912	Per Cent Decrease 1911 vs 1910	1912 vs 1911	1912 vs 1910
Jan.	23.34	23.56	25.78	-8.69	-0.85	-9.46	$84,397.08	$89,428.99	$-7,334.11	$-760.15	$-8,459.98	-7,334.11	-760.15	-8,459.90	374.04	357.58	349.74	4.60	2.24	
Feb.	22.47	23.91	24.23	-6.02	-1.32	-7.26	73,669.41	78,432.31	-4,436.10	-1,035.31	-5,694.19	-11,770.21	-1,795.46	-14,154.17	374.95	350.03	318.17	7.12	10.01	
Mar.	20.70	22.82	24.30	-9.29	-6.37	-15.09	77,551.22	85,686.88	-7,204.51	-5,458.25	-12,930.15	-18,974.72	-7,253.71	-27,084.32	324.60	314.56	316.75	3.19	-0.69	
Apr.	20.23	21.16	21.91	-4.40	-3.42	-7.67	68,032.35	63,031.80	-3,028.62	-2,183.05	-4,895.90	-22,003.34	-9,436.76	-31,980.22	327.86	279.59	292.65	17.26	-4.46	
May	20.98	19.81	22.21	5.91	-10.81	-5.54	68,322.92	73,795.88	4,037.88	-7,977.33	-4,088.29	-17,965.46	-17,414.09	-36,068.51	307.19	273.68	279.60	12.24	-2.11	
June	20.28	19.27	21.33	5.24	-9.66	-4.92	65,219.46	70,961.95	3,417.50	-6,854.92	-3,491.33	-14,547.96	-24,269.01	-39,559.84	304.69	255.52	277.13	19.24	-7.80	
July	20.60	19.20	18.74	7.29	2.45	9.93	66,500.89	66,951.17	4,847.91	1,640.30	6,648.25	-9,700.05	-22,620.71	-32,911.59	301.46	256.34	250.93	17.60	-1.00	
Aug.	20.69	19.08	18.83	8.44	1.33	9.80	66,266.42	63,012.73	5,594.57	917.87	6,810.46	-4,105.48	-21,710.84	-26,093.13	299.40	247.71	274.04	20.86	-9.61	
Sept.	21.69	19.48	19.02	11.34	2.42	14.04	65,045.97	68,185.30	7,376.21	1,650.08	9,578.22	3,270.73	-20,060.76	-16,519.91	305.03	246.74	270.70	23.62	-8.85	
Oct.	21.53	20.59	20.69	4.57	-0.49	4.06	69,552.57	64,623.60	3,178.55	-316.67	2,623.80	6,449.20	-20,377.43	-13,896.11	322.69	274.39	264.01	17.60	3.93	
Nov.	23.57	22.04	20.73	6.94	6.32	13.70	74,316.16	70,518.77	5,158.54	4,456.79	9,661.07	11,607.82	-15,920.64	-4,233.04	335.62	292.90	282.76	14.55	3.61	
Dec.	24.85	22.18	21.35	7.53	3.89	16.40	78,823.57	78,228.70	5,935.31	3,043.10	12,829.51	17,543.13	-12,877.54	8,594.47	365.95	294.34	298.28	24.33	-1.32	

*Indicates Increase

Fuel Consumption on the Frisco.

them. Formerly, in putting on new firemen, we gave them a student letter, to be endorsed by three engineers with whom they had ridden. There was a tendency for them to ride with the engineers who they thought would endorse their letter, or firemen with whom they were acquainted, although these engineers and firemen might not be the most skillful men. We now tell the student firemen who to ride with, and before accepting service they are interviewed by the assistant superintendent of locomotive fuel service, who either approves or rejects their application.

We try to anticipate the need of firemen and to have desirable men in view for these positions.

For the men already in service, we have a first, second and third year's progressive examination. The knowledge gained through discussion and study is reflected in the work of the firemen. It is natural that a fireman, having told the instructor the proper way to fire an engine, will endeavor to carry out this practice.

In making trips over the divisions where the performance is good, a record is made of the trip by the assistant superintendent of locomotive fuel service. A copy of this record sent to the division superintendent and the crews are given credit for skillful operation. A copy of this letter and record trip is frequently attached to the personal record of the crew.

We try to impress on the firemen that we want to have the engines so that the work will be comfortable for them. We want them to do their work in the easiest way, which is by carefully preparing the fire at the terminals, firing light and often, and keep fire as clean as possible. The instructions to the fireman are made so that the engineer will be agreeable to them and have them carried out when we are not on the engine. At best, we can be with one crew only a small per cent of the time, and it is largely the personal pride they take in their work that counts. If one crew can handle a seven-car, all-steel passenger train over a division of 119 miles and not take water over the entire division; another crew handle a local passenger train of seven cars over a 286-mile division and only take water twice, with a tank of 7,000 gallons capacity; or another engineer and fireman with a freight engine handle 90% of the engine's potential rating and run 97 miles between water tank stops, it indicates that a first-class fuel performance is being made and that the engine is in first-class condition; that the work is less arduous for the fireman than if the opposite were true, and it further indicates that we should try to bring the other engines and crews as nearly as possible up to this standard of efficiency. I do not mean by this that they should necessarily make the same run between water tanks, but such performance shows that neither fuel or water had been wasted.

Item 5. "Engines not in good condition." One of the most important factors in fuel economy is the condition of the engine. It is not possible, of course, to have an engine 100% all the time. It is essential that draft appliances be maintained to standard, that is as nearly as possible to what is found to be correct dimensions, for the different classes of engines, and if engine does not steam freely, the trouble should be looked for elsewhere. If the engine burns a level fire and the proper location of petticoat pipe and draft sheet has been determined for this class of engine, there is very little gained by moving the petticoat pipe up or down, or changing draft sheet; there is more likely to be a leak in steam pipes or exhaust joints. The first thing to ascertain is, whether the flues are thoroughly clean, and whether there are any holes in grates, around the grate bearing bars or dump grates, and if there is plenty of air opening in the ash pan. If these items are found to be correct, a water test should be put on the steam and exhaust pipes. A very prevalent cause for waste of fuel is that of reducing the nozzles. Engineer may report on the work book "Reduce nozzle; engine is not hard enough on fire." This is sometimes done at the suggestion of the fireman after the fire has become clinkered. There may be several causes entirely apart from the nozzle, such as flues leaking or stopped up, netting stopped up, leak in fire box or smoke arch, improper running or firing, or a number of other causes, and with the defect remedied, there would be no necessity for reducing the nozzle. But if nozzles are allowed to be reduced indiscriminately, it is probable that some other defects at least may not be corrected. The contracting of the nozzle calls for a heavier fire to be carried on this engine than on other engines of the same class and may result in fireman firing engines that have not had nozzle reduced, heavier than is required, with the result that another fire is spoiled and another engine is reported not steaming. We record the size of nozzles on the monthly engine condition report. It is first determined what size nozzle the engine will steam with freely, after having made allowance for varying conditions, and with standards established for each type of engine slightly smaller than our tests show engine will steam freely with, we maintain same. In the roundhouse we keep a slotted board to put down in the nozzle bridge and occasionally insert this in the stack and thus check actual measurements with the measurements reported.

Some very valuable tests conducted by the Santa Fe show that engines equipped with a nozzle as large as is used on the average railroad, shows the back pressure in cylinders, at times, to be equal to the pull at draw-bar, which means that as much of the power of the locomotive is used in creating draft under these conditions as is used in pulling the train. From this the premium that is paid for contracting nozzles unnecessarily, or neglecting to clean them out, is readily seen, and this feature should not be left to the discretion of some one in the roundhouse that would prefer to contract the nozzles rather than go after the real cause of the trouble.

Another cause for waste of fuel lies in valves so set that engines cannot be worked in the most economical cut-off. We found this was especially apt to occur on large freight engines equipped with slide valves. Unless this is specialized on and tests are made to show the difference in fuel consumption of an engine working at long stroke or in close cut-off, the shops may not be particular to set valves so that engines can be worked properly. It was found by marking the cut-off on the quadrant, that the minimum point at which engine could be worked was frequently not closer than 11 or 12 inches on slide valve engines having 22x30-inch cylinders. Valves were then squared up to work at any point in cut-off and it was found

FREIGHT									TOTAL					
Cost of Freight Fuel		Reduced Cost			Accumulative Reduction			Combined Frt and Pass. Reduction			Combined Accumulative Reduction		
1911	1912	1911 vs 1910	1912 vs 1911	1912 vs 1910	1911 vs 1910	1912 vs 1911	1912 vs 1910	1911 vs 1910	1912 vs 1911	1912 vs 1910	1911 vs 1910	1912 vs 1911	1912 vs 1910
6.95	$176,038.46	$152,202.36	$8,097.77	$3,409.33	$10,578.07	$8,097.77	$3,409.33	$10,578.07	$763.66	$2,649.18	$2,118.09	$763.66	$2,649.18	$2,118.09
17.85	163,920.53	153,882.44	11,671.14	15,403.63	27,468.02	19,768.91	10,812.96	38,046.09	7235.04	14,368.32	21,773.83	7,998.70	17,017.50	23,891.92
2.48	161,955.84	174,807.45	5,166.39	-1,206.17	4,335.22	24,935.30	17,606.79	42,381.31	-2,038.12	-6,664.42	-8,594.93	5,960.58	10,353.08	15,296.99
12.03	135,071.70	131,428.48	23,313.38	-3,861.71	15,810.85	48,248.68	11,745.08	58,192.16	20,284.76	-8,044.76	10,914.95	26,245.34	2,308.32	26,211.94
9.87	136,308.50	151,730.73	16,684.16	-3,201.52	14,975.82	64,932.84	8,543.56	73,167.98	20,722.04	-11,178.85	10,887.53	46,967.38	-8,870.53	37,099.47
9.94	120,334.30	150,826.39	23,152.43	-11,764.47	14,992.16	88,085.27	-3,220.91	88,160.14	26,569.93	-18,619.39	11,500.83	73,537.31	-27,489.92	48,600.30
16.43	113,834.97	147,192.89	20,034.95	-1,471.93	24,183.79	108,120.22	-4,692.84	112,343.93	24,882.86	168.37	30,832.04	98,420.17	-27,321.55	79,432.34
9.25	117,582.71	167,776.04	24,527.75	-16,123.28	15,519.28	132,647.97	-20,816.12	127,863.21	30,122.32	-15,205.41	22,337.74	128,542.49	-42,526.96	101,770.08
12.68	120,012.86	161,226.08	28,347.04	-14,268.51	20,443.47	160,995.01	-35,084.63	148,306.68	35,723.25	-12,618.43	30,016.69	164,265.74	-55,145.39	131,786.77
22.23	144,612.99	152,183.31	25,451.89	5,980.88	33,830.79	186,446.90	-29,103.75	182,137.47	28,630.44	5,664.21	36,454.59	192,896.18	-49,481.18	168,241.36
18.69	150,794.75	169,158.80	21,940.64	6,106.64	31,615.79	208,387.54	-22,997.11	213,753.26	27,099.18	10,563.43	41,276.86	219,995.36	-38,917.75	209,518.22
22.69	142,493.27	175,156.23	34,668.61	-2,312.06	39,742.95	243,056.15	-25,309.17	253,496.21	40,603.92	731.04	52,572.46	260,599.28	-38,186.71	262,090.68

Office of General Coal Agent, St. Louis, Mo.

Fuel Consumption on the Frisco (Continued).

that the 5-inch notch was the most desirable minimum cut-off for this class engine. Quadrants have been similarly stenciled on one or two engines of nearly every class.

It would take up too much time to mention even a small per cent of the items that have been given attention with reference to engine conditions. Our mechanical people try to make things as convenient as they can on the engines and are very appreciative of suggestions. Enginemen themselves are continually making suggestions that help the fuel performance, and we try to carry them out whenever practical. When going into detail, I am reminded of a remark made by a gentleman who is a pioneer in fuel economy, who in talking before this club on one occasion, asked the question: "Could a man tell another one how to become a good fuel agent in five minutes?" I refer to Mr. Thomas E. Adams, who has done magnificent work on the line with which he is associated, in securing a proper locomotive fuel performance.

Item 6. "Fuel not up to contract grade." The assistant superintendents of locomotive fuel service inform themselves as to the contract grade of fuel used on their divisions and learn something of the accounting of fuel. They occasionally visit the mines and notice the quality of the coal as it is loaded. Our fuel department maintains a very close inspection on the quality of coal and distributes it to burn one grade of fuel on each division where it is possible to do so. Since the fuel economy department was established, we have made tests and certain changes in the distribution with good results.

Item 7. "Shortage of coal reaching pockets." Aside from pilfering, or coal that may be taken for cabooses from the cars of coal intended for locomotive use (and which has always been provided for by the fuel department by charging to each caboose in service an amount shown by test to be approximately correct, crediting locomotives with this amount), this is simply a matter of securing correct weights and is closely looked after by our weighing bureau and the fuel department.

Item No. 8. "Fuel used for other purposes and improperly charged to engine use." This item refers to the incorrect distribution of fuel primarily charged to locomotives, but which is diverted at roundhouses, shops and elsewhere for miscellaneous purposes.

A careful canvass of such divertments was made over the entire line and steps taken to see that the proper transportation roadway or shop account was charged with the fuel consumed by it, and proper credit, in return, given the open fuel account, thus relieving the locomotives of a miscellaneous tonnage that they did not consume. While such mischarging did not occur on our lines to any material extent, unless watched continuously, a mishandling of this character is liable to creep in with resultant disadvantage to the locomotive fuel performance.

By cooperating with the fuel and special service departments we have practically overcome the pilfering of coal. This is a public evil that is probably not thoroughly appreciated. We should try to disabuse the mind of the trespassing public of the idea that coal in transit or standing in railroad yards or even on the ground at coaling stations is nobody's or everybody's property. This applies to commercial as well as to railroad shipments.

To establish a proper fuel performance sheet, much depends upon the correctness of the daily coal report furnished from the coaling stations. This is apt to be lost sight of. It is a simple report to make out, but it is very necessary that close attention be given it to secure accurate figures, representing the actual amount of coal given to the engine.

When visiting terminals, the assistant superintendents of locomotive fuel service check up a great many things from a fuel standpoint and give special attention to the end that engines are charged with the exact amount of coal they receive.

It is very important also that engineers familiarize themselves with the amount of fuel required to fill tank and make out tickets for the exact amount ordered, for in the event of taking coal from connecting lines or mine tipples on line, they are, in a way, the purchasing agents of the company they represent.

We feel that we gain a great deal by making a daily performance sheet. While varying conditions will cause engines to burn more fuel one trip than another, even though hours of service may be practically the same, the most important point of daily entries is that it affords an opportunity to locate errors in fuel distribution or to check one engine against another engine in the same class of service, and which could not be discovered in any other way. It is of no advantage to compare one division with another, or one road with another. The only true comparison is, as before stated, to find out what it is possible to do in each class of service and establish that as a standard to work to. Another point in favor of the daily record is that division officials learn more concerning the items that affect the fuel cost per car mile and per 1,000 gross ton miles, such as terminal consumption, light engine movement, doubleheading, delays on line and many other things. Due to so many different items affecting fuel consumption, it is difficult to explain fuel increases 30 to 60 days after the fuel is consumed without some data being kept during the time the fuel is being used. Post-mortem examinations are scientifically useful in a general way, but do not help the individual examined, unless they could be held in accordance with the suggestions of one Clancy, who, upon hearing of the demise of his friend, Hennessey, on whom a post-mortem examination had been held, disclosing the cause for Hennessey shuffling off the mortal coil, remarked that "If the fool doctors had had sense enough to make the post-mortem examination ten days ago, Hennessey might have been alive yit."

The clerk handling the performance sheet also attends to the correspondence of the assistant superintendent of locomotive fuel service, and it is his duty to furnish proper information regarding engines making poor performance.

A blue-print letter size, containing concrete information, is posted at each roundhouse not later than the 15th of each month, showing the performance on each division in each class of service for the previous month, a red line indicating the division showing the best performance in each class of service. A bulletin is issued by the superintendent each month addressed to all employes, showing the loss or gain in dollars and cents as against the previous month, and some brief comment is made

on items that require special attention in order to make further improvement.

BULLETIN

Chaffee, Mo., May 11, 1913.

To All Concerned:

Below are figures showing comparison of Locomotive Fuel Performance for the months of March and April, 1913.

PASSENGER SERVICE

Class of Ser.	Car mls. or ton mls. April	Car mls. or ton mls. March	Lbs. coal per car or per 1000 ton mls. April	Lbs. coal per car or per 1000 ton mls. March	Percentage Inc.	Percentage Dec.
Thru Pass.	125,801	136,467	19.21	19.11	.52	....
Loc. Pass.	184,535	272,907	21.93	21.22	3.34	....
General Average	310,336	409,434	20.84	20.52	1.55	....

FREIGHT SERVICE

Thru Freight	30,036,721	71,366,770	210	179	17.31	....
Loc. Freight	29,668,140	18,100,040	272	353	....	22.94
Gen. Average	59,704,861	89,466,810	241	214	12.61	....
Mixed Ser.	13,676	13,370	107	143	....	25.17
Work Ser.	22,454	3,035	134	104	19.23	....
Switch Ser.	16,626	17,670	97	98	....	1.02
Motor Car	4,467	4,680	.81	.87	....	6.90

Approximate loss in through pass. service amounts to		$ 12.58
Approximate loss in local pass. service amounts to		130.92
Approximate loss in through freight service amounts to		931.14
Approximate gain in local freight service amounts to	$2,403.12	.....
Approximate gain in mixed service amounts to	492.34	.....
Approximate loss in work service amounts to	.....	449.08
Approximate gain in switch service amounts to	16.63	.....
Approximate gain in motor car service amounts to	19.43	.....
Total saving all classes service for month	$2,931.52	.....
Total loss in all classes service for month	.....	$1,523.72
Balance showing total saving for month	$1,407.80	.....

The above figures show a nice decrease for the month when performance is taken as a whole, but it is readily seen that none of this saving is with our passenger men. I believe that it is possible for our passenger crews to give us a better report and believe they could by a little effort do more than they have been doing toward saving fuel. I am not going to criticise any one, but I would like to have an expression from every passenger engineer in a letter, outlining what you consider is some reason for the increase in passenger performance, also submitting any suggestion you may have to offer for economy in fuel.

Yours truly,

(Signed.) E. BARCLAY,
Asst. Supt. Loco. Fuel Ser.

Approved:
(Signed.) O. H. McCARTY,
Superintendent.

BULLETIN.

To All Concerned:

Below are figures showing Locomotive Fuel Performance on the Kansas Division for month of April compared with March, 1913.

Class of Service—	Car—Gross Tons— or Engine Miles April	Car—Gross Tons— or Engine Miles March	Lbs. Coal Per Car Gross Ton or Engine Mile April	Lbs. Coal Per Car Gross Ton or Engine Mile March	Lbs. of Coal Incr.	Lbs. of Coal Decr.
Local Passenger	243,295	254,651	20.40	21.27	....	.87
Through Freight	21,894,531	23,861,535	221.00	230.00	....	9.00
Local Freight	14,692,031	10,439,580	329.00	390.00	....	61.00
Gen'l Aver. Freight	36,586,562	34,301,115	264.00	279.00	....	15.00
Switch	20,079	20,428	100.00	113.00	....	13.00

The approximate saving in passenger service was 106 tons, or	$ 244.00
The approximate saving in through freight service was 98 tons, or	225.00
The approximate saving in local freight service was 448 tons, or	1,030.00
The approximate saving in switch service was 131 tons, or	301.00
The total approximate saving was 783 tons, or	$1,800.00

The above figures show the result of what can be accomplished by practicing fuel economy. During the month of April the engines on this division performed about the same amount of work that they did in March, using 783 tons less coal, which represents a saving of $1,800.00.

This saving was made by those handling and using coal in being careful to avoid any loss by excessive consumption, which, I assure you, will be appreciated by all officials. However, I know that a further saving can be made by engine men exercising care to avoid engines popping. All engines will perform the work they have to do with five or ten pounds less steam than popping point except on very hard pull, and even then they should not pop. Also in reducing black smoke; this can be accomplished by putting in light charges of coal and maintaining high temperature in fire box, which you must have to ignite the hydro-carbon gas; and will result in a further saving each month.

Yours truly,

(Signed.) AL GEISTER,
Asst. Supt. Loco. Fuel Service.

(Signed.) H. H. BROWN,
Superintendent.

Item 10. "Other matters that may require attention." Good feed water is an important item. It is not always practical to obtain this. On one division we found in making tests in passenger service that as high as 20% of the fuel used was due to the excessive amount of water blown out of the boiler. By applying smaller injectors, securing more continuous boiler feed, which is particularly desirable where water is treated in engine tanks, and by careful handling of the engine, we found we could eliminate the worst tanks and almost entirely avoid the use of blow-off cocks on passenger trains. The following message will show that specializing in this particular work gave good results:

"Houston, May 15, 1913.

"Train 104 today, engine 480, Kingsville to Houston, with six cars, made only two water stops, at Refugio and Bay City, 286 miles; .8 gallon of oil per car mile."

This was later done with seven cars.

It is an excellent plan to cultivate the acquaintance of the flue borer and the man who looks after the grates and to go into a firebox occasionally, as well as to visit the coal chute.

Things that are learned in this way cannot be found out in any other way, and it convinces these men that you are interested in their work and that they are an important asset in obtaining the proper use from fuel.

Sufficient draft through the ash pan is very important. It takes a great deal of air to burn coal properly. It is estimated that 20 pounds or 260 cubic feet of air is required for the proper combustion of one pound of coal, or 3,900 cubic feet for each shovelful. Just after the law was enacted requiring dump pans to be applied to engines, some ash pans were made that were nearly water tight.

One thing that is frequently lost sight of is the relative cost of lubricants and fuel. I have in mind one division where the approximate cost of fuel was $83 and the cost of lubrication 45 cents for a round trip of about 500 miles. I don't advocate wasting oil. There should be an oil schedule, but oil schedules are sometimes made similar to fuel tests; there is someone along watching it. The lubricator never runs away. The engine oiling is done just before leaving the terminal or intermediate station. In daily service, the engineer has a number of other things to look after besides the lubricator. He is not infallible and may forget to ease off the lubricator feeds or watch the guide cups at the first stop. He should, of course, watch this closely, and those having supervision over the crews should keep this feature in mind. An engine should not be run with dry valves or cylinders. The engineers should carry extra oil with them and keep the engine well lubricated at all times. If careless in the use of oil, handle that on its merits, but it is just as reasonable, in my opinion, to say we could have just so much coal to make the trip with as to start the engineers out without an emergency supply of oil, to use in case something should happen on the line. When the work was first taken up we gave each engineer an extra one-half gallon of valve oil, keeping a record of the extra oil and a close check on the amount of oil used by each engineer for a month, to see whether it was advisable to increase the oil schedule to save fuel. At the end of thirty days we found it was not necessary to increase the oil allowance, but it is understood that we do not want to save oil at the expense of fuel.

Attention to detail is highly essential to locomotive operation. Things that are seemingly unimportant may have a decided effect on the final results. It can be safely left to the general officers to furnish new appliances. It is for us who are held responsible for the result, to keep posted and determine the best possible methods of handling such appliances to secure the maximum efficiency.

Keeping engines of a certain class in one working district is essential to proper fuel performance. Neither enginemen or shopmen can learn the proper care of an engine in one trip. The argument that an engine is an engine, and a man that knows his business ought to do as well with one as with another, is wrong and is based on false premises. Circumstances require sometimes that engines be shifted around considerably, but this is invariably done at the expense of the fuel bill.

The whole problem resolves itself into a question of hearty coöperation on the part of all concerned. Anything that will help to establish a proper fuel performance on the railroad will help every other item of train operation. The work cannot possibly be departmentized. Every department on our line tries to help out in every way they can. The shop people gladly accept suggestions that make engines more economical in fuel and as comfortable for the enginemen as possible. They are very generous in inviting criticism in this respect. The same is true of the fuel department. Any changes that can be brought about in the handling or purchase of fuel that are practical are worked out.

Securing as nearly as possible a maximum tonnage rating for each locomotive is highly important for a proper fuel perform-

ance also. Of course, for obvious reasons, all of these things cannot be done at once. All of the engines are not right all of the time, neither are they all wrong all of the time, and this is also true of the men, and statements of this character should not be taken too seriously. When things go wrong, a good getting together is the best way to remedy them. We derive a great deal of benefit from the educational meetings held at the different points, and also from the different staff meetings, held by the division officials. With the best system or method that can possibly be maintained, human error will always furnish the need of a very close supervision. Any device placed on the locomotive tends to make it more complicated and requires that the men who are handling it be taught its proper use, and this emphasizes the need for greater education. Great good can be done in reducing the fuel bill of railroads by exercising proper care in the selection of our firemen, who will later become engineers and who will have under their supervision in the course of their career probably 50 to 100 other firemen, all of whom will profit more or less by the engineer's training. The need of firemen should be anticipated. These men, once employed, should be properly educated to perform their duties skillfully, and if they do not show aptitude, should not be allowed to remain in a vocation that they are not adapted to. A constant effort should be made to familiarize not only the enginemen but engine handling forces and mechanics the right way to handle and care for locomotives, and their work should be checked up often enough to know that it is done in the right way.

In conclusion I wish to say that the one thing that has done more to reduce the fuel bill on the Frisco Lines than anything else is the interest and loyalty displayed by our engineers and firemen, and it is only to be regretted that we cannot carry out all of the suggestions made by them as rapidly as we would like to.

SOME PREVENTABLE INJURIES IN THE OPERATION OF LOCOMOTIVES.

By George Bradshaw, Safety Engineer, Highland, N. Y.

The first annual report of the chief inspector of locomotive boilers contains a tabulation of 43 classes of defective conditions in boilers and their appurtenances and gives the number of accidents due to each condition according to information furnished by the railroads of the United States for the year ending June 30, 1912. The 43 classes of defects were responsible for 856 accidents in which 91 persons were killed and 1,005 were injured. Many of the defects were undoubtedly latent and could not have been foreseen and guarded against. But 457 of these accidents, or 53.4 per cent of the entire number were due to *only three* of the classes of defects enumerated and *these three classes are entirely preventable.* They are:

Breaking of water glasses	165
Breaking of lubricator glasses	49
Squirt hose connections	243

Since injuries due to the breaking of water and lubricator glasses are often serious, sometimes involving impairment or loss of vision, the necessity must be conceded for adequate safeguards. Scores of devices have been designed for the purpose, especially for water glass protection. It is perhaps safe to say that tests have shown the great majority of these devices to be without merit. But some of them are both practicable and effective. Mr. D. R. MacBain, superintendent of motive power of the Lake Shore & Michigan Southern, has recently developed a guard which has satisfied severe experimental tests and is giving satisfaction in actual service. This guard has the very material advantage that it can be constructed and applied at a very small expense. It consists of a frame of light metal of triangular outline surrounding the ordinary tubular glass. The back of the frame which is next to the boiler is of solid material, the two sides consist of thick glass slides which can be readily removed or inserted and which afford a view of the gauge. The whole forms a complete enclosure from which a tube extends through the deck floor. In case of explosion, the steam, water and broken glass from gauge are carried through the tube outside the cab. Another safety fitting has been placed on a number of Union Pacific locomotives by Chas. Fuller, assistant general manager and W. J. Hatz, master mechanic.

What is known as the Klinger glass is used to a considerable extent. This device consists of a metal receptacle for the water in the front side of which is one narrow thick bar of glass. Grooves on the inside of the glass bar produce a light refraction which makes the water appear ink black. This is a very decided advantage over other types as it enables enginemen to readily observe the state of the water. It is claimed, however, that corrosion and chemical effect of the water especially if containing alkali, result in wearing or eating away the grooves and also the edges of the glass bar, thus causing leakage.

Since recent Federal regulations require water gauges—the wisdom of the requirement being in the opinion of many questionable—they must, of course, be installed and the matter of testing and adopting protective devices should receive careful attention. As already stated, practicable and effective devices exist and it is largely a matter of selection.

The protection from lubricator glasses is not a problem of great difficulty and it has been solved on many lines as indicated by the comparatively small number of accidents (49) shown in the report mentioned. One system operating about 2,000 miles has not had an injury from broken lubricator glasses in years. This system uses "the bull's eye" lubricator.

Injuries due to squirt hose slipping from connecting pipe, while not as a rule serious, are most numerous and involve considerable loss of time. Such injuries can be prevented by either of two methods. (1) By making the hose connection to the pipe outside the cab and running the hose into the cab. One objection to this method is that it causes considerable wear on the hose where it extends through the side of cab, unless specially protected. (2) By using cold, instead of hot, water in the squirt hose. This can be accomplished by inserting in the leg of the water tank a tank of about twenty to thirty gallons capacity provided with proper valves and connections so that the compressed air from engine will fill the tank, the squirt hose being attached to a pipe extending from the small tank. This device, of course, makes impossible an injury on account of disconnection of hose. It also has the further advantage of prolonging the life of the hose about one-third due to the use of cold water. A device of this nature has been constructed by Mr. Joseph Chidley, assistant superintendent of motive power, Lake Shore & Michigan Southern, and has given satisfaction in actual service.

One of the most prolific sources of injury is to be found in shaker bars. Such injuries are hardly ever serious, but they are nevertheless most annoying. The ordinary shaker bar depends entirely upon gravity and friction for remaining in contact with the lug. This is not sufficient for safety. The bar comes off and falls upon the foot of the man operating it or causes him to lose his balance and strike his hand or body against the boiler head. Such injuries are entirely preventable by the simple means of providing the opening in the bar with a horizontal pin or bolt in such position that it will drop down by gravity and engage in a notch or recess on the back edge of the lug. This attachment holds the bar securely to the lug regardless of the direction of the force applied in operating the bar. The release of the bar from the lug is effected by a simple pressure of the foot shoving the head of the bolt or pin (which extends on the outside of the opening) backward beyond the edge of the notch in the lug.

ALL-STEEL NARROW GAUGE HOPPER CARS.

The Pressed Steel Car Company recently turned out at its Pittsburgh plant a lot of narrow gauge hopper cars for the East Broad Top Railroad & Coal Company, for operation between Mt. Union, Pa., and Orbisonia, Pa., these being the only all steel narrow gauge hopper cars in use on any of the railways of the United States. These cars are for carrying coal from the mines to the main line of the Pennsylvania at Mt. Union and they have proven to be superior to the wooden cars which have previously been used on account of the greater carrying capacity and decreased cost of maintenance.

The cars are 60,000 pounds capacity, built for 3′-0″ gauge track and weigh about 20,700 pounds each, distributed 12,000 pounds to the body and 8,700 pounds to the trucks. Based on the average amount of coal being loaded in these cars, the ratio of paying freight to total weight of car when loaded is 73½ per cent.

The general dimensions of the car are as follows:

Length inside	25′ 7″
Width inside	7′ 6″
Width over side stakes	8′ 0⅜″
Length over striking plates	27″ 4¾″
Height from rail to underface of body, side bearing	1′ 10½″
Height from rail to center of coupler	2′ 2″
Distance center to center of trucks	18′ 4″
Height from rail to top of body	8′ 6″
Height from rail to top of brake mast	8′ 11½″
Length of drop doors in clear	3′ 1⅞″
Width of drop doors in clear	2′ 6″

The various items of specialties with which the cars are equipped are as follows:

Air brakes, Westinghouse schd. KD-812.
Center plates, malleable iron.
Side bearings, pressed steel body and malleable iron truck.
Coupler, Climax, ¾″ size cast steel, 4″x4″x20″ shank.
Door operating gear, Lind.
Draft rigging, Miner.
Trucks, arch bar type.
Axles, O. H. S., with 4″x7″ journals.
Arch bars, open hearth steel.
Column posts, malleable iron.
Spring planks, 12″ pressed channel, $\frac{5}{16}$″ thick.
Truck bolsters, pressed steel bathtub type.
Brake beams, pressed steel channel type.
Brake shoes, Speer & Miller steel back.
Journal bearings, per P. S. C. Co. Spec. J-2-b.
Journal boxes, McCord malleable iron.
Waste, wool.
Journal wedges, malleable iron.
Boss lock nuts.
Truck springs, M. C. B. class ″A″; 2 inside coils omitted in each group.
Wheels, grey iron, 24″ dia., 400 lbs. each—Lobdell Car Wheel Company.
Paint, 2 coats outside and 1 coat inside, brown, per P. S. C. spec PA-2.
Safety appliances, interstate commerce commission laws.

From the photograph it will be noted that in general appearance there is no marked difference between the car described above and the ordinary hopper car in use on standard gauge roads.

All Steel Narrow Gauge Hopper Cars.

The body bolsters are built integral with underframe and each bolster consists of one ¼″ O. H. S. web plate with malleable iron center brace and reinforced at top with a flange and the floor of car, and at the bottom with a 12″x⅜″ plate and 3″x3″x$\frac{5}{16}$″ rolled angles. There is one cross bearer located across center of car made of angles and $\frac{3}{16}$″ plates.

The car is equipped with four doors, located near center of car, and made of $\frac{3}{16}$″ pressed steel reinforced by flanges and channels. The doors are operated by the ″Lind″ door gear, the operating shaft being 2″ in diameter.

The four diagonal braces extending between bolsters and end sills are made of 3½″x3½″x¼″ rolled angles. The end sheets are ¼″ thick reinforced at top and bottom with a flange; the floor sheets are $\frac{3}{16}$″ thick and the side sheets $\frac{3}{16}$″ thick reinforced at top by a 3″x3″x$\frac{3}{16}$″ rolled angle and at bottom by a 3″x3″x¼″ angle and vertically with seven stakes of $\frac{3}{16}$″ pressed steel. The two center sills are made of 10″ 20-lb. channels and extend between bolsters being tied together and reinforced at top with a 15½″x¼″ plate 3′ 9½″ long over each bolster. The draft sills are also 10″ 20-lb. channels, extending from end of car to about 2 feet back of bolster. The end sills are 6″ 8-lb. channels and sub end sills are ¼″ pressed steel reinforced at top and bottom with flanges and at coupler opening with O. H. S. striking plate, to which is bolted the coupler carrier made of 3½″x3½″x⅜″ rolled angle. The side sills are 6″ 8-lb. channel, extending from bolster to end sill.

DEVICE FOR TESTING AIR SIGNAL EQUIPMENT.

By F. W. Bentley, Jr.

The parts of the air signal equipment are in a great many instances regarded as secondary in importance in so far as giving them a rigid and a careful test after overhauling is concerned. In a great many shops where the management was extremely liberal and co-operative in the development of shop testing devices for air brake parts, the writer has seen money needlessly squandered in other costly and unresultant experiments along this line. Though not an imperative necessity, the device described below for testing the parts of the air signal equipment is one which will instantly reveal the defects if there

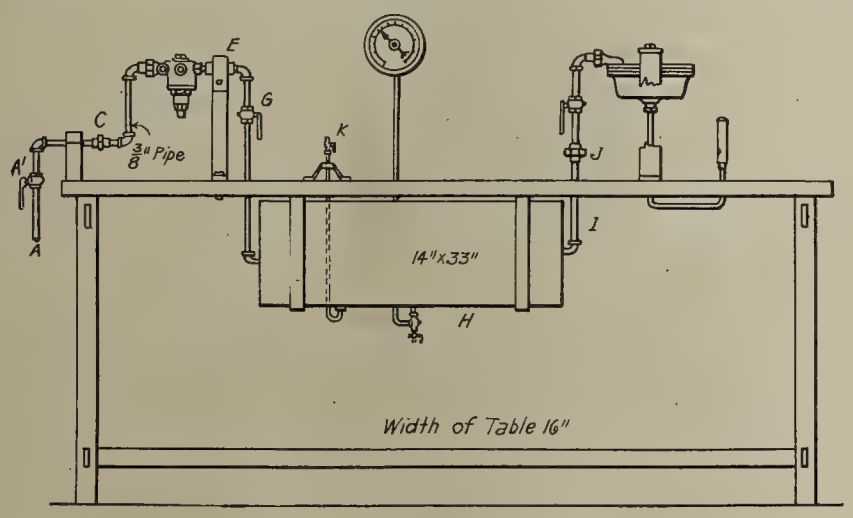
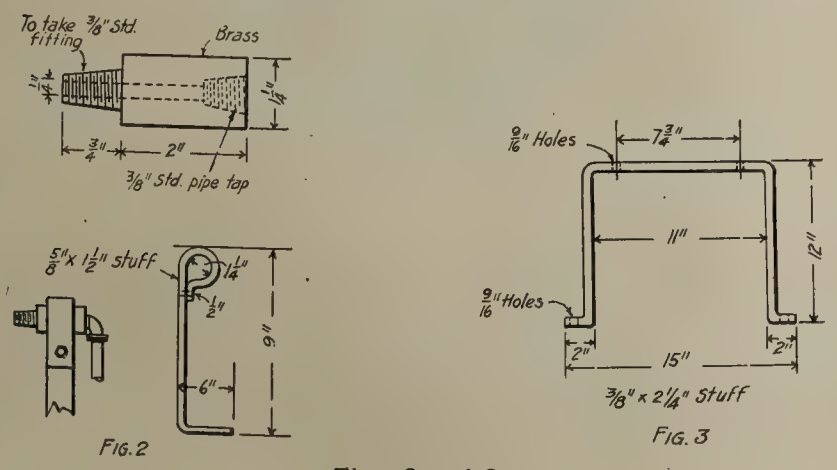


Fig. 1.

be any, and will consequently leave the workman or foreman with no doubt as to any points easily overlooked or undiscovered.

The whole arrangement can be constructed in any moderately equipped shop without an order on the storekeeper for extra material. The 14"x33" volume reservoir is something generally available from the usable material taken from scrapped engines. The bench for the greater part is of straight flat pieces easily ripped in the planing mill. Descriptive of the general construction of the device, an explanation is made from Fig. 1.

Plant or house air at the usual pressure of from 100 to 120 pounds enters the piping of the device at A, where it is checked or permitted to flow on by the cut-out cock A'. From beyond the cut-out cock it is conducted by 3/8-in. pipe to the main reservoir connection of the reducing valve on test, which is screwed



Figs. 2 and 3.

upon and held by the stand E. Beyond the reducing valve, the air is carried into the volume reservoir H through the cut-out cock G. From the reservoir H, the air flows into the whistle valve through pipe I. This circuit of air is figuratively the same as that in the signal line upon the locomotive and train, the reservoir H corresponding to a small part of the signal line pressure in the piping reaching back of the engine through the coaches.

The union C should be of the ball joint type, as it is loosened each time to facilitate the coupling of the small union nut on the reducing valve. The reducing valve stand E is in two parts, but rigid in form to permit the application and removal of reducing valves repeatedly being placed under inspection. The details of its construction are shown in Fig. 2. The male feature of the brass nipple enables the reducing valves to be instantly applied and tightened.

The details of the whistle valve stand are shown in Fig. 3, two ½-in. bolts being all that is required to tighten and hold the valve rigidly in place. The ball joint union J is for the purpose of freely breaking the rigidity of the pipe I while connecting the union to the whistle valve. The bleed-cock K is for slightly reducing the pressure in the volume reservoir while testing the responsiveness of the whistle valve.

A glance at the location of the cut-out cocks will show how the following tests can be rapidly performed:

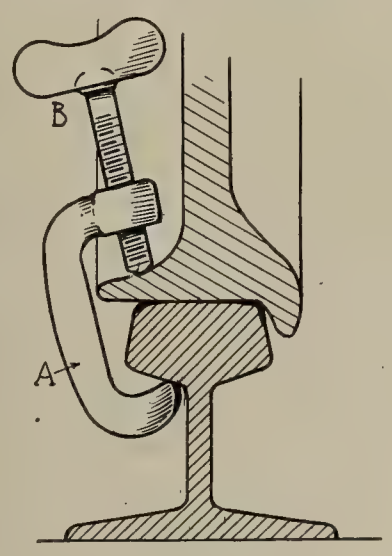
1. Leakage or overcharging test of the reducing valve.
2. Rapidity of charging by reducing valve, and consequently the errors in length of the supply valve stem and piston.
3. Sensitiveness of diaphragm in whistle valve.
4. Condition of seat at bottom of diaphragm valve stem by watching gauge hand after closing cut-out cock G.

No mechanic's work is so thorough at all times that it is entirely free from oversight or mistake, but the above device will eliminate the consequences of faulty workmanship and insure a perfectly repaired part of the signal equipment when applied to the locomotive.

WHEEL HOLDER.

Editor Railway Master Mechanic:

The accompanying sketch shows a device that our car men at this point have developed for the purpose of holding down the



Wheel Holder.

wheel while the journal box is being jacked up for brassing and it is just as effectual as it is simple.

The clamp body (A) is made of one inch square tool steel; that part of the clamps against the rail has a hardened chisel point, and is in line with hardened point of three-quarter inch thumb-screw (B). The screw is three inches long under the head. It has been tried in all shapes of rims with success.

J. A. JESSON,
L. & N. R. R., Corbin, Ky.

KINDLING LOCOMOTIVE FIRES.

By E. A. Murray, M. M., Chesapeake & Ohio Ry., Clifton Forge, Va.

Economy in railway operation is no doubt being followed up more closely at this time than ever before in the history of this particular branch of industry; however, I will wager that thousands of dollars are being spent annually in kindling locomotive fires of which there is no use.

The subject was pretty well set out in a paper written by C. F. Richardson, of the C. R. I. & P. R. R., and presented before

the South and Southwestern R. R. Club at Atlanta, Ga., January 19, 1911. The method of kindling locomotive fires described and recommended in the paper is as follows:

"Bed the grates with coal to a depth of three or four inches, after which cover the coal with two or three bushels of oil-soaked shavings. The shavings can then be ignited by throwing in a small handfull of burning waste."

With an increase in the cost of crude oil from 1¾ cents to 4¾ cents per gallon, and the price still going up, it put us to thinking as to how to best make a reduction in the cost of this operation and upon making a test by using the shavings without being oil-soaked, we found that the oil could be omitted without any noticeable effect in the time required to generate steam, unless it was in favor of method of firing up without the oil being used. This is accounted for by the quickness in which the shavings will burn when oil-soaked, whereas, without oil we find that the flame will be of longer duration and will necessarily ignite the coal better; especially is this true when using slow-burning coal.

Our consumption of fuel oil at this point averages fifty gallons each twenty-four hours. By eliminating the use of oil, we have accomplished a saving of $56.25 per month or $675.00 per annum, which in my opinion is a nice saving.

The subject of kindling fires in locomotives is a live one, and one which should be looked into by the operating department of the railroads of this country.

Personals

Robert W. Bell has been appointed general superintendent of motive power of the Illinois Central, succeeding Morgan K. Barnum, resigned. Mr. Bell's headquarters are at Chicago, and his jurisdiction also extends over the Yazoo & Mississippi Valley.

Joseph H. Nash has been appointed superintendent of motive power of the Illinois Central lines north of the Ohio river, with office at Chicago. Mr. Nash was formerly superintendent of the Burnside shops.

Frank B. Barclay has been appointed superintendent of motive power at the Illinois Central lines south of the Ohio river, with office at Memphis, Tenn. Mr. Barclay was formerly master mechanic at McComb, Miss. His jurisdiction also extends over the Yazoo & Mississippi Valley.

W. J. Ridley succeeds G. H. Truman as road foreman of engines of the Northern Pacific at Dilworth, Minn.

Jos. M. Boyd, assistant general air brake inspector of the Northern Pacific, has been appointed trainmaster, with office at Fargo, N. D.

W. A. Robertson succeeds V. Smith as foreman car repairs of the Central of Georgia, with office at Columbus, O.

H. W. Gardner succeeds F. H. Hanson as supervisor of material, locomotive and car department, Chicago, Indiana & Southern and the Lake Shore & Michigan Southern. His office is at Cleveland, O.

F. G. Hill has been appointed superintendent of the Chicago, Milwaukee & St. Paul, vice J. F. Richards, transferred. His office is at Mobridge, S. D.

G. G. Davis has been appointed superintendent of shops of the Cleveland, Cincinnati, Chicago & St. Louis at Beech Grove, Ind. He succeeds R. J. Williams.

J. G. Heiser has been appointed district car foreman of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Springfield, O.

A. G. Brown has been appointed district car foreman of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Indianapolis, Ind.

F. D. Miller has been appointed district car foreman of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Mattoon, Ill.

F. T. Wissinger has been appointed general foreman of the Detroit, Toledo & Ironton, with office at Springfield, O. He succeeds W. J. Davis.

H. G. Koch has been appointed locomotive foreman of the Great Northern at Butte, Mont., succeeding C. W. Brady.

F. W. Ramer has been appointed locomotive foreman of the Great Northern at Glascow, Mont., succeeding B. K. Franklin.

L. M. Miller has been appointed locomotive foreman of the Great Northern at Billings, Mont., succeeding Lee Hoagland.

J. Doherty succeeds W. Brennan as car foreman of the Great Northern at Kelly Lake, Minn.

Wm. Smith succeeds C. C. Fowler as car foreman of the Great Northern at Minot, N. D.

E. W. Bowans has been appointed general superintendent in El Salvador for the International Railways of Central America with office at San Miguel, El Salvador. He succeeds J. B. Allen.

E. E. Messmer succeeds F. T. Chase as master mechanic of the Missouri, Kansas & Texas, with office at Smithville, Texas.

J. F. Trevino has been appointed road foreman of engines of the Interoceanic Ry. of Mexico, with office at Pueblo, Pueb., Mex.

George O. Hammond has been appointed assistant mechanical superintendent of the New York, New Haven & Hartford, with office at New Haven, Conn. Mr. Hammond was formerly assistant to the mechanical superintendent.

H. C. Oviatt has been appointed assistant mechanical superintendent of the New York, New Haven & Hartford, with office at New Haven, Conn. Mr. Oviatt was formerly general inspector.

J. L. Crouse has been appointed superintendent shops, electric division of the New York, New Haven & Hartford, with office at Van Nest, N. Y.

Joseph McCabe has been appointed master mechanic of the Shore Line division of the New York, New Haven & Hartford, with office at Harlem River, N. Y. Mr. McCabe was an engineer from 1885 to December, 1902, at which time he was promoted to road foreman of engines on the Western division. In February, 1907, he was made general road foreman of engines and in July of the same year was made master mechanic at Waterbury, Conn., which position he held until his present appointment.

C. H. Reid has been appointed master mechanic of the Western division of the New York, New Haven & Hartford, with office at Waterbury, Conn., succeeding Joseph McCabe. Mr. Reid was formerly general road foreman of engines.

F. W. Nelson has been appointed general road foreman of engines of the New York, New Haven & Hartford, with office at New Haven, Conn., succeeding C. H. Reid. Mr. Nelson was formerly road foreman of engines of the Western division.

C. L. Hickey has been appointed assistant superintendent of the Montana division of the Oregon Short Line, vice George Baker, assigned to other duties. Mr. Hickey's headquarters are at Pocatello, Idaho.

Wm. H. Leonard succeeds D. E. Davis as storekeeper of the Philadelphia & Reading, with office at Port Reading, N. J.

V. R. Plank succeeds F. J. Clifford as storekeeper of the Southern Pacific at Oakland Pier, Cal.

Robert Manning has been appointed storekeeper of the Southern Pacific at Stockton Cal., succeeding V. R. Plank.

A. S. Johnson succeeds J. J. Coakley as superintendent of the Terminal Railroad of St. Louis, with office at St. Louis, Mo.

W. H. Davis has been appointed roundhouse foreman of the Texas & New Orleans at Echo, Texas. He succeeds C. A. McLarty.

A. F. Helm has been appointed division superintendent of the Wabash, with office at Detroit, Mich.

H. F. Grewe has been appointed master mechanic of the Wabash Pittsburgh Terminal and the West Side Belt, with headquarters at Rook (post office Carnegie), Pa.

Alfred H. Egan has been appointed general superintendent of the Yazoo & Mississippi Valley succeeding George W. Berry, resigned. His headquarters are at Memphis, Tenn.

Harry E. Myers has been appointed shop superintendent of the Lehigh Valley at Packerton, Pa. Mr. Myers was born March 12, 1880, at St. Joseph, Mo., receiving his education in the public schools at that place. He entered railway service in 1897 on the K. C., St. J. & C. B., now a part of the Burlington system, serving a machinist apprenticeship. Subsequently he served as a machinist on the Burlington at La Crosse, Wis., and on the Hannibal & St. Joe at Hannibal, Mo. On February 17, 1903, he entered the service of the Union Pacific at Omaha, Neb., and successfully filled the positions of piece work inspector, gang foreman and assistant to the general foreman. On August 1, 1905, he entered the service of the Santa Fe at Fort Madison, Ia., as general machine shop foreman, leaving this position on December 1, 1906, to become shop inspector for the Lehigh Valley at Sayre, Pa. On October 1, 1912, he was promoted to assistant master mechanic on the New York, New Jersey and Lehigh division of the same road, which position he held until his present appointment.

Harry E. Myers.

E. F. Kearney, who has just been elected first vice-president of the Texas & Pacific, with headquarters at New Orleans, La., and Dallas, Texas, has been general superintendent of transportation of the Missouri Pacific-Iron Mountain System. He will have entire charge of maintenance, operation and traffic for the Texas & Pacific, as the president, George J. Gould, has headquarters in New York. Judge Thomas J. Freeman, who has been first vice-president and general counsel, will remain in the capacity of general counsel. The new active head of the Texas & Pacific is one of the most capable railroad men in the country and one of the most popular. Born in Logansport, Ind., March 27, 1865, Mr. Kearney began his railroad career with the Pennsylvania in 1882 as telegraph operator. Later he was made chief train dispatcher and then trainmaster. He came to St. Louis as superintendent of the Terminal Railroad Association and served successively as general superintendent of transportation of the Frisco, superintendent of terminals for the Missouri Pacific at St. Louis, superintendent of transportation for that company, and finally as general superintendent of transportation for the system.

F. E. Hutchison has resigned as electrical engineer of the Chicago, Rock Island & Pacific.

G. E. Scott has been appointed assistant purchasing agent of the Missouri, Kansas & Texas, with headquarters at St. Louis, Mo.

T. M. Vickers has been appointed general foreman of the Oregon Short Line, with office at Pocatello, Idaho.

C. C. Colley has been appointed purchasing agent of the Louisiana Ry. & Navigation Co., succeeding G. E. Smith. His office is at Shreveport, La.

F. H. Hanson.

F. H. Hanson has been appointed assistant master car builder of the Lake Shore & Michigan Southern with office at the Collinwood shops. Mr. Hanson entered railway service in 1891 as a freight checker at Elkhart, Ind., filled the position of night baggageman in 1892, road fireman during 1893, and entered the car department at Elkhart in 1894, serving as car checker, cleaner, repairer and inspector. In 1901 he was made night foreman of the car department and in 1904 was promoted to general foreman, car department at the same location. In 1908 he was made division general foreman and transferred to Collinwood, O. On January 15, 1912, he was promoted to supervisor of material, locomotive and car department with office at Cleveland, holding this position until May 1, 1913, when he was promoted to assistant master car builder.

Industrial Notes

Announcement is made by C. A. Seley, formerly mechanical engineer of the Rock Island Lines, of the organization in Pittsburgh of the American Flexible Bolt Company. The company will manufacture locomotive stay bolts and other bolts embodying a new method of construction, invented and developed by Ethan I. Dodds, formerly connected with the Erie Railroad and the Pullman Company. The preliminary tests and experiments have resulted so satisfactorily that the company organization has been effected and will actively enter the commercial field. The general offices are in the Union Bank Building, Fourth and Wood streets, Pittsburgh, Pa. The shops of the company are at Zelienople, Pa., thirty-two miles west of Pittsburgh, on the main lines of the B. & O., B. R. & P. and the Harmony Trolley Line, a very excellent shipping and manufacturing point. Machinery for a very considerable production has been installed and is in operation, and the property of the company will permit con-

venient expansion as the business is developed. The officers of the American Flexible Bolt Company are: C. A. Seley, president; J. A. Frauenheim, vice-president and general manager; H. T. Frauenheim, secretary and treasurer; Ethan I. Dodds, chief engineer.

The Baldwin Locomotive Works is preparing to begin construction on the first unit of its new plant at East Chicago, Ind., for which approximately 370 acres of land was purchased last year.

The Davis Brake Beam Company has been formed by H. H. Weaver, of Johnstown, Pa., and his associates, and has taken over the control of the Davis Solid Truss Brake Beam Company, Wilmington, Del. As soon as a suitable site is secured, the works will be brought to the Pittsburgh district, possibly some place near Johnstown. The new plant will be considerably larger than the present one. F. R. Weaver is manager.

Chas. R. Wescotts has been elected secretary and treasurer of the M-C-B Co., with office at Chicago, Ill., Mr. Wescott is a railroad man of long experience and has been connected in an official capacity with the Erie, Southern, Illinois Central and the Chicago, Peoria & St. Louis, and has a host of friends among the higher class railroad officials throughout the country.

W. S. Murray has resigned as electrical engineer of the New York, New Haven & Hartford and has formed a partnership with E. H. McHenry, who recently resigned as vice-president of the New Haven, under the firm name of McHenry & Murray, engineers. The firm will specialize in railway electrification work, including plans, estimates, construction and operation.

The firm of Burton W. Mudge & Co. has changed its name to Mudge & Company, and the general offices in Chicago have been removed from the Peoples' Gas building to the Railway Exchange building.

The Standard Coupler Company, 2 Rector street, New York, has moved its general offices to 30 Church street, New York.

American Mason Safety Tread Co. sold some $50,000 of safety treads to railroad and car building companies in 1912, which shows how extensively the railroads of the country are realizing the value of safety devices that will prevent slipping. Aside from the above the company did a large business with its Karbolith fireproof sanitary car flooring and its Stanwood non-slipping self-cleaning car steps.

The Zug Iron & Steel Co., Pittsburgh, Pa., has moved its general offices to the 7th floor of the Park building.

The Lima Locomotive Corporation has appointed G. Haven Peabody to represent the company in Western territory. New offices have been opened, 520 McCormick building, Chicago. With the approaching completion of the company's enlarged plant at Lima, Ohio, they will be in excellent position to take care of heavy railroad business.

The McKeen Motor Car Co., of Omaha, Neb., recently shipped a 70-ft. 200-horsepower steel gasoline motor car to the Oregon-Washington R. R. & Navigation Co., North Yakima, Washington. The car made the entire trip of 2,000 miles on its own wheels and under its own power in charge of an expert operator from the works. This company has also shipped two 55-ft. gasoline motor cars to the Minneapolis & Northern. This is a 22-mile interurban line which has been built for operation exclusively with McKeen gasoline motor cars. It runs from Minneapolis to Anoka.

The Pilliod Bros. Co. has been succeeded by the Standard Valve Gear Co., 1212-14-16 Oakwood avenue, Toledo, Ohio.

Samuel Hoffman, vice-president of the Locomotive Superheater Co., with office at 30 Church St. New York, has moved his headquarters to Germany, where he will continue in the same line of work. George L. Bourne, vice-president, who has until recently made his headquarters in Chicago, has taken active charge of the affairs of the company and for the purpose of obtaining better supervision has moved his office to New York.

The Buda Co. announces the establishment of a headlight department for the manufacture and sale of the Buda-Ross electric headlights, for use on locomotives, small stationary plants and boats. Mark A. Ross, who has been engaged for sixteen years in the manufacture and sale of electric headlights; Harry P. Bayley, for thirteen years sales agent in the headlight industry, and John Eberhart, who for sixteen years has been manufacturing headlights, have become associated with the concern. Mr. Ross will have entire charge of the headlight department, with the above mentioned men at the head of their respective departments. The Buda-Ross electric headlight will be on exhibition at the Master Mechanics' Convention at Atlantic City, June 11th to 18th inclusive.

Independent Pneumatic Tool Company's exhibit at the Master Mechanics' and Master Car Builders' conventions at Atlantic City, June 11-18, will be located in booths 583 and 585. A complete line of Thor air tools will be shown, including drills of the center-spindle and close-quarter types, reversible flue rolling, reaming, tapping and wood-boring machines, grinders, pneumatic riveting, chipping, calking and flue-beading hammers, pneumatic staybolt drivers, holders-on and other air appliances. The Thor electric drill which this company has recently placed on the markets will also be exhibited. Representatives will be in attendance as follows: James Buchanan Brady, John D. Hurley, Ralph S. Cooper, F. H. Charbono, Harry F. Finney, George A. Gallinger, W. R. Gummere, Vernon Job, Walter A. Johnson, George J. Lynch, R. A. Norling, Robert T. Scott, John P. Bourke. Mr. Vernon Job will make the trip from San Francisco to attend the convention.

It is not often that a manufacturer in any line maintains for a period of more than fifty years the highest possible standard of quality, refusing to follow false prophets, but always picking out, after exhaustive test, the new things which are worthy of perpetuity. This is peculiarly true of the Stewart Hartshorn Co. The name "Hartshorn" is an assurance of perfect operation in a curtain roller and a guarantee of excellence in this class of car equipment, either in a spring roller or a sash balance. More and more the traveling public is demanding the best, and the mechanical departments of the operating lines, as well as the car builders, are every year making strenuous efforts to meet this condition, with the result that the use of these rollers is becoming more extensive in passenger car construction.

New Literature

Tate, Jones & Co., Inc., of Pittsburgh has published a booklet on Blacksmithing and Drop Forging. This is the second booklet which has been issued on this subject. This booklet takes up the subject of heavy forging.

* * *

Beaudry & Co., Boston, Mass., has issued a booklet descriptive of Beaudry power hammers. These are built in two types: the Champion, for light and heavy railway, machine and general forging; and the Peerless, for plating, drawing, swaging, collaring, spindle-making and general manufacturing.

* * *

"Dixon Graphite Brushes" is the title of a recent booklet of the Jos. Dixon Crucible Co., of Jersy City, N. J. In addition to complete rules for using the brushes under various conditions of service there are also included valuable suggestions for using Dixon's lubricating rods for manufacturing arc light plungers, oilless bearings, dashpots, and for other applications where oil or grease lubrication cannot be conveniently employed.

* * *

Chicago Pneumatic Tool Company's Compressor department bulletin No. 34-L, of the Chicago Pneumatic Tool Co., Chicago, is just off the press. This bulletin is one of the series covering the company's complete compressor line and treats particularly of general engineering information of value to users of compressed air. It contains tables giving efficiencies of air com-

pression at different altitudes, density of gases and vapors, mean effective pressures and horse powers, loss of pressure due to friction in pipes, and many others, some rare and all important. Also information for intending purchasers, showing the data required for intelligent estimates. Views of various types of compressors are shown, as well as illustrations showing the interior of the Chicago Pneumatic Tool Company's compressor plant at Franklin, Pa.

* * *

The Safety Car Heating & Lighting Co. of New York has issued an attractive pamphlet on the subject of "Safety Electric Light," which sums up briefly the advantage of this company's system of car lighting.

The National Tube Co., Pittsburgh, Pa., has published a booklet entitled "Matheson Joint Pipe." This is a system of piping for high or low pressure, natural or artificial gas lines, water works, hydro-electric works and other uses. The pipe has a bell and spigot joint very similar in appearance to a cast-iron pipe joint but applied to wrought pipe.

* * *

The Cleveland Pneumatic Tool Co., Cleveland, O., has issued a catalogue of Cleveland air tools which is very complete and which handles the subject in comprehensive and readable style. Included in this line of air tools are hammers, core breakers, drills, flue rolling machines, wood boring machines, grinders, rammers, valve grinders and hose couplings and clamps.

Among The Manufacturers

LABOR SAVING SHOP EQUIPMENT.

A recent development in labor saving and safety first equipment for railroad shops is a portable floor crane and hoist "The Handiest Tool in the Shop" made by the Canton Foundry & Machine Co., Canton, Ohio, one type of which is illustrated herewith. This crane with one man operating it, will hoist and convey an article weighing up to 4,000 lbs. to and from points inaccessible to overhead traveling cranes, and entirely eliminate the danger of accidents to workmen in handling castings and heavy parts by hand. Objects some distance away can be drawn to the tool with the chain, making it possible to reach any part of the shop, however remote. Its construction is such that it is absolutely dependable, being made of high grade material throughout, carefully machined and well fitted parts and equipped with guaranteed-hand-forged-tested chains. The wheels are roller bearing, and all fixtures are drop forged. They are made in many types to fit the varying conditions pertaining in different shops.

This company also manufactures an industrial turntable possessing many admirable features, among which is a serpentine ball bearing track, which reduces the friction to a minimum, as the table rests only on those balls at the upper portion of the track, the other balls rolling down into the pockets, where sufficient oil is stored to last an entire year. It is very durable, there being nothing in its construction to allow it to get out of order, and a heavy load does not cause it to turn any harder than a light one.

Still another shop accessory made by this company which has superior points of merit is the Canton alligator shear, a notable feature of which is that it is double geared, preventing the twisting of drive shaft—the working strain being equally distributed on each side saves much wear on gears and bearings.

Portable Floor Crane and Hoist.

RUMSEY CAR DOOR AND UNITARY STRUCTURE.

In connection with the increasing attention being paid to car maintenance, it is of interest to note claims made by the Rumsey Car Door and Equipment Co., of having solved the door question wholly eliminating the losses incident to faulty door construction, through the medium of a pressed steel recessed post, so anchored to the super-structure at top and bottom, as to become an integral part of the car, into which their door interlocks in such a manner as to become a firmly anchored part of the car itself.

The door and unitary steel structure are evidently designed along practical mechanical lines, and by practical railroad men of long experience in car uses and abuse, and would seem to warrant the attention of mechanical and operating officials as promising relief from a source of great loss and annoyance, particularly so as it requires no departure from existing standards, and can be introduced gradually through unit installations, either new or rebuilt.

The application of the same principles governing the freight car door to postal, baggage, express and refrigerator cars is the next step contemplated, and these plans reveal the same correct analysis of condition as are exhibited in this company's freight car equipment.

VARIABLE LOAD FOUNDATION BRAKE GEAR.

A promising and very interesting feature on exhibition at the mechanical conventions this year is the variable load foundation brake gear shown by The Bettendorf Company, and which is in the form of an empty and load brake, with many theoretical possibilities that appear to be realized in practical form in this equipment.

The advantages claimed for this equipment over the present standard brake arrangement are:

1st. Increased load weight brake power.

2nd. Decreased empty weight brake power, hence less likelihood of wheel sliding.

3rd. Increased brake power for one truck if that truck only is loaded.

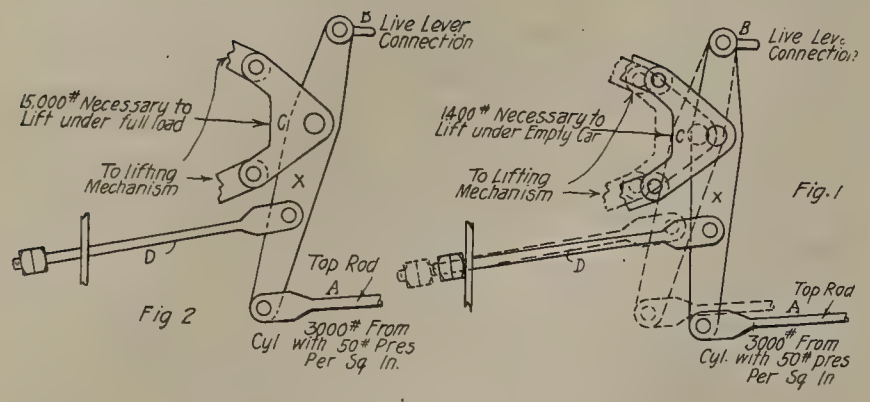
4th. Parts are all mechanical and requires no skill for renewing or repairing.

5th. Entirely automatic in action.

6th. Less likelihood of pulling mixed trains in two from emergency applications.

The same general idea was shown last year in a different form, but the several improvements have apparently eliminated objections in previous designs.

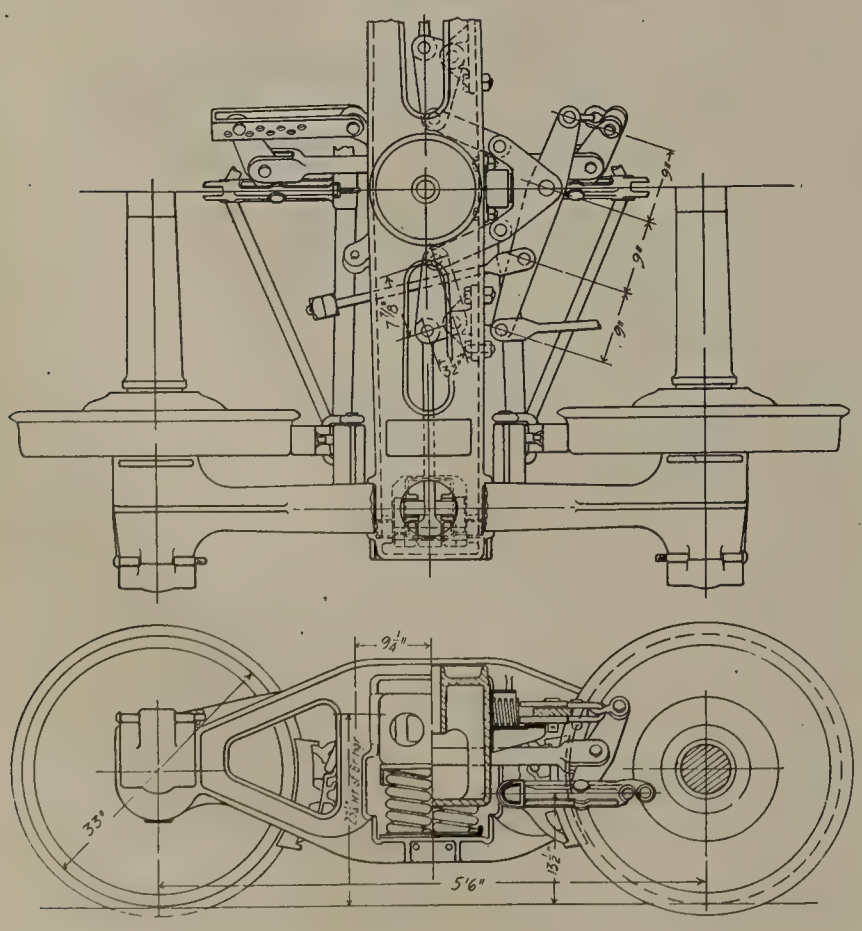
The device is based on the idea of applying the cylinder and lever proportions for the desired load weight brake power



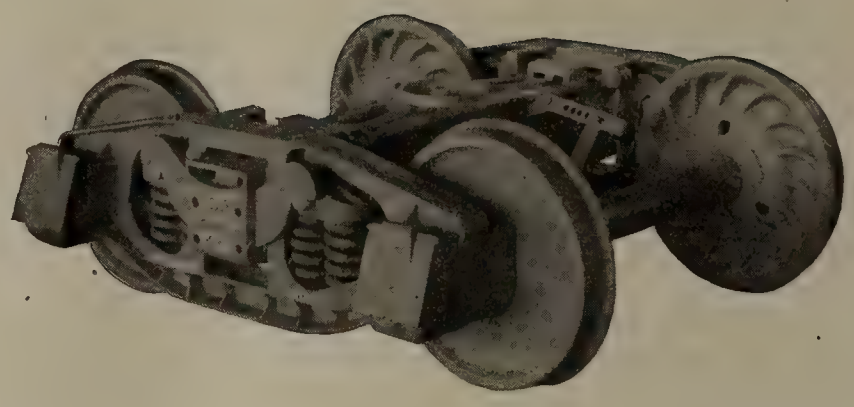
Diagram, Variable Load Brake Gear.

and utilizing a series of parts, (which are capable of lifting the car body) as a fulcrum for one of the levers. This fulcrum will not move unless the brake cylinder force becomes equal to some predetermined percentage of the downward force due to the weight of the car body and the load thereon, but when the brake cylinder force does not exceed the predetermined amount the car body will be lifted and the before mentioned lever, through the movement of its primary fulcrum, assumes a new position in which a supplementary fulcrum comes into play. When this supplementary fulcrum becomes active, four forces are effective on this lever, the resultant at the top of the live lever being much less with a constant cylinder force than when the car is so heavily loaded that no lifting occurs and only three forces are effective.

This is perhaps better understood by means of diagram Fig. 1 where X is a lever with four connections with A as the top rod transmitting cylinder force to said lever X, B a connection to truck live lever wherein the compression rod is between the brake beam and connection B. C is a connection to that series of parts capable of lifting the car body and which connection is capable of movement when the brake cylinder force exceeds a certain percentage of the weight of the car body and load thereon. D is a connection which acts when C moves and the nuts on D come into engagement with the back of the bolster. The fulcrum at C is connected to a series of parts capable of lifting the car body and assuming that the force necessary to lift the empty car body is 1,400 pounds and the force necessary to lift the fully loaded car is 15,000 pounds; with 50 pounds cylinder pressure, there is a force of 3,000 pounds resulting in rod A.



Application of Variable Load Brake Gear to Truck.

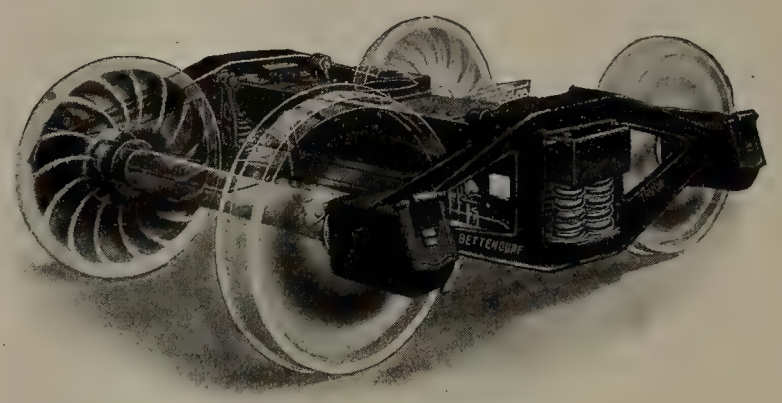


From Fig. 1 we have computed the forces for a compound lever (since 3,000 pounds cylinder force will overcome the 1,400 pounds lifting force and produce movement)

$$\frac{3000\times9-1400\times9}{18} = 2200 \text{ lbs. effective at the top of the live lever.}$$

Under a fully loaded car assume it will require 15,000 pounds to lift the car body and load. 3,000 pounds will not overcome 15,000 pounds at the fulcrum, hence we have the condition of Fig. 2, wherein 3,000 pounds at rod A = 6,000 pounds at B top of live lever.

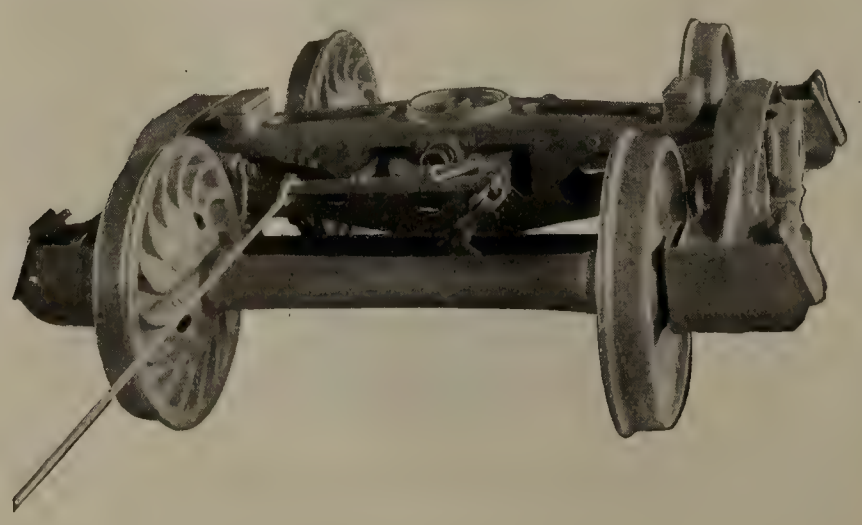
By means of this scheme the load of the car body plays a part in determining the effective force at the brake shoes and both the amount of brake cylinder force and weight of

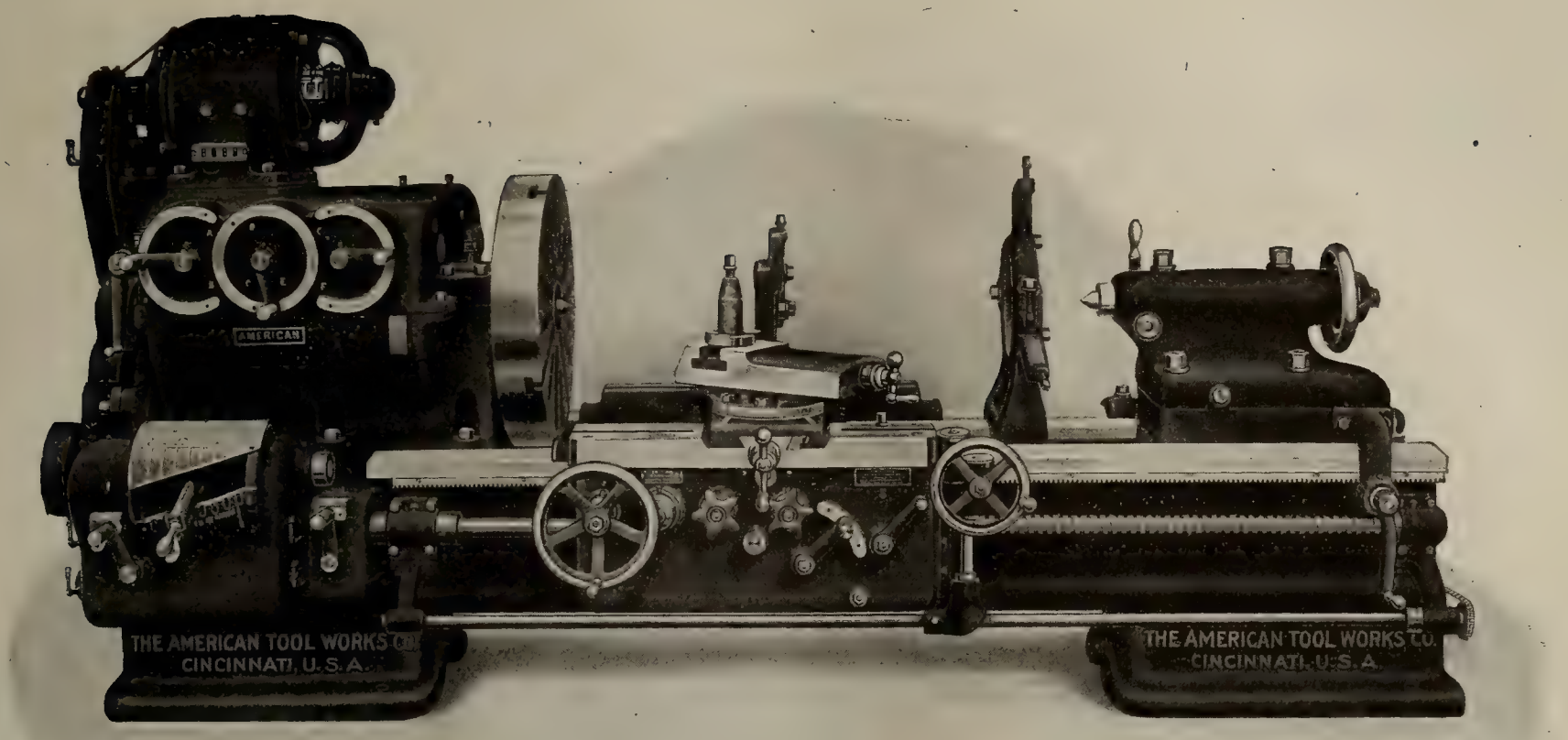


car body and load thereon is necessary for the determination of the brake shoe force.

For if 1,400 pounds is the resistance offered by the empty car body when the car is lightly loaded the resistance will increase as the load increases. Hence the 1,400 pounds effective at C with an empty car will gradually increase as the load increases, and in so doing effects the resultant force at the top of the live lever so long as the brake cylinder force is sufficient to lift the car body and load thereon.

This lever combination with its many variations, makes it possible to secure any desired range of empty and load weight brake power for any constant air brake cylinder force and especially so when a spring is interposed to partially balance the lifting force at C for the empty car body.





"American" Lathe With New Patented Gear Head.

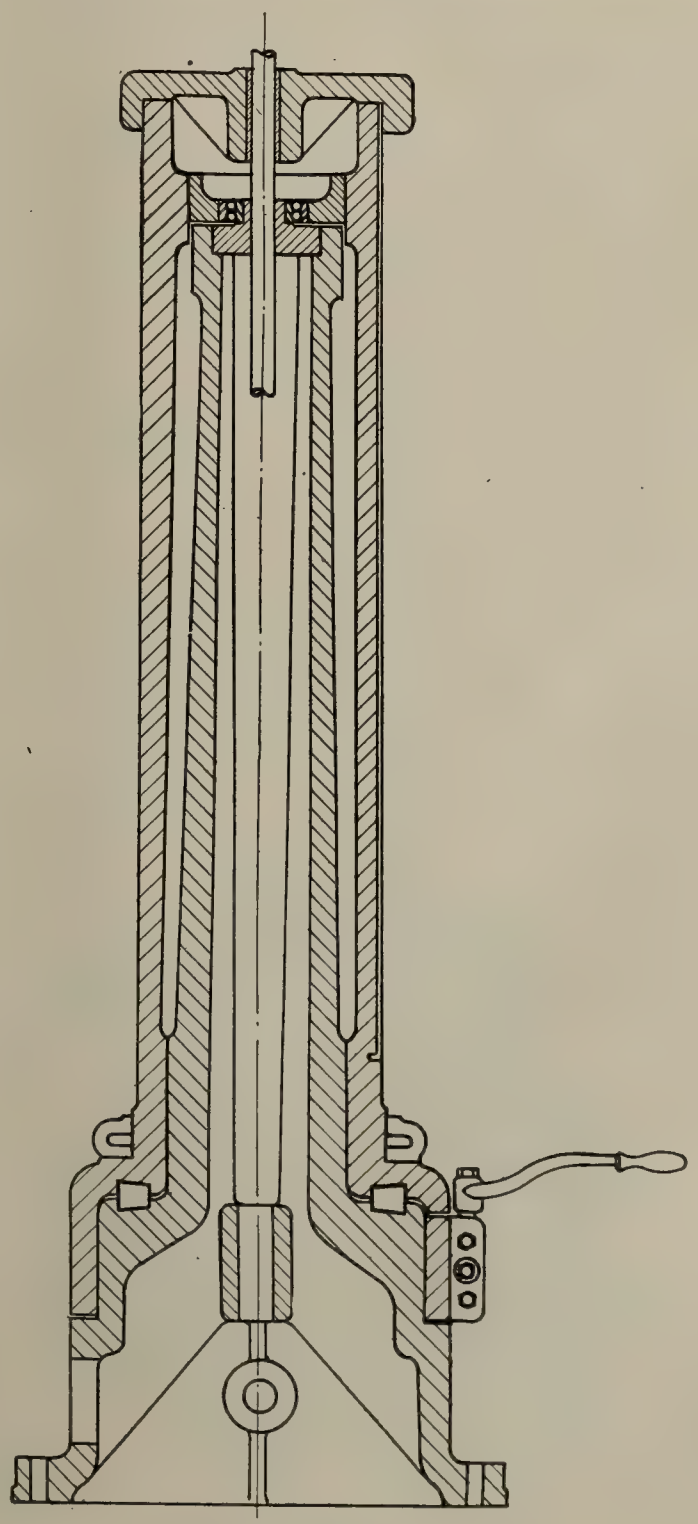
"AMERICAN" TOOLS.

The past year has witnessed quite a number of important improvements in the product of The American Tool Works Company of Cincinnati, Ohio.

For example, a new twelve-speed patented geared head has been developed for its 30-inch and 36-inch lathes. The head referred to is shown in an accompanying illustration. Twelve spindle speeds are obtained from 6 to 260 R.P.M. by operating the levers on front of the head. An index plate conspicuously located on the head indicates plainly how to obtain the different speeds. Some idea of the power this head will transmit can be gained from the fact that the maximum gear ratio afforded is at the unusually high rate of 43.3 to 1. The head is massively proportioned and possesses sufficient rigidity to resist all strains to which it may be subjected. The simplicity of this head is an important feature. Only 12 gears are used to produce the 12 spindle speeds. The gears are cut from the solid with special cutters, are of wide face and unusually coarse pitch and are tested for accuracy on a special gear testing machine. The teeth of the slip gears are "machine rounded" to facilitate meshing. The driving pulley is of large diameter and affords a large area of belt contact. It runs on a massive bronze bushed steel sleeve, thus relieving the driving shaft of all belt strains. The pulley has an improved automatic oiling system which insures proper lubrication at all times. A sensitive but powerful friction clutch is provided in the driving pulley, which is controlled by a convenient drop lever, by means of which the gears in the head can be stopped or slightly moved without interfering with the driving belt, thus permitting speed changes to be easily made. All shafts in the head are of high grade steel and are accurately ground. The headstock bearings are of the best quality of phosphor bronze with excellent lubricating facilities, including sight feed oilers for spindle bearings. This headstock can be quickly and easily converted into motor drive at any time after installation, by simply removing pulley drive unit and placing a motor on top of headstock and connecting motor to driving shaft of head through spur gearing.

Another marked improvement will be noted from the accompanying sectional drawing of the "American" 6 and 7 ft. plain radial drill column. It will be seen from this illustration that a ball bearing has been interposed between the column and sleeve at the top, which takes the side or radial thrust of the sleeve and makes the swinging of the arm exceptionally easy.

The sleeve, or outer column, revolves on hardened and ground



Plain Radial Drill Column.

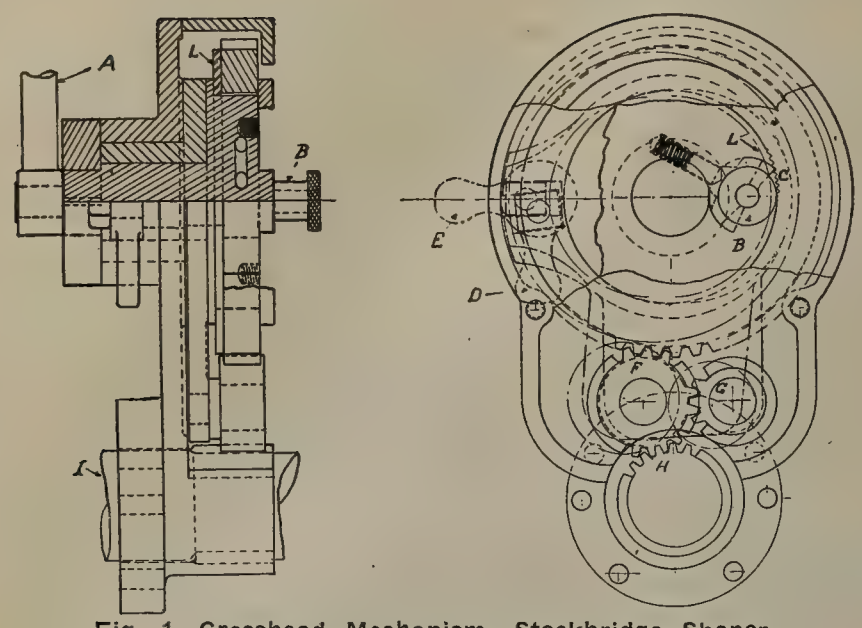


Fig. 1—Crosshead Mechanism, Stockbridge Shaper.

conical roller bearings, and may be easily swung around and quickly clamped in position by means of our unusually powerful eccentric clamping device. This binds the sleeve firmly to the inner column, which extends entirely through and has full bearing for the sleeve at both top and bottom.

It will be further noted that all gears in these machines are made of steel, the pinion being cut from the bar, while the large gears are cut from steel castings. The gears in the gearbox and the mitre gears in the column stump are cut from a special steel, and are carbonized and hardened.

Improvements have also been made in the American full universal radial drills. In addition to the new type of column and clamping arrangements as described above, the construction and location of the tapping attachment has been changed.

This mechanism is now embodied in the saddle mechanism, which makes possible the use of much larger frictions than could formerly be used when the tapping attachment was located at the girdle in the arm. As a consequence, the power output of these machines has been greatly increased. This mechanism is now operated through spur gears, the beveled gears as commonly used in tapping attachment having been eliminated by new construction, which also adds to the life and efficiency of the machine.

HOMESTEAD VALVES.

There are three essential features to be considered when attempting valve construction; they are simplicity, utility and durability. While the plug cock type has from the beginning comprehended the first of these factors, as it used to be made it was lacking in wearing quality and ease of action. On account of this, manufacturers turned their attention for a number of years to globe valves, and while for a time they seemed to accomplish something in the way of improvement they were always open to a great objection, leakage. Next followed the gate valve which proved to be entirely too complicated in its mechanism to be satisfactory.

The Homestead Valve Mfg. Company, of Pittsburgh, Pa., with works at Homestead, has gone back to first principles, using the plug valve as a starting point from which to progress to a perfected article. The result is a valve which is safe, reliable, tight, easy of operation and most durable. It is claimed that Homestead valves may be depended upon to make a tight joint, regardless of the pressure passing through the valve.

In the old style plug valve, in order to prevent leaking, it is necessary that the plug be held so tightly in the body of the valve as to render turning difficult or even impossible without loosening the nut and breaking with a hammer the contact between plug and body. Then when the plug is thus loosened, there is nothing to prevent leakage around the plug or even its entire blowing out if the nut has been removed. Many disastrous accidents have resulted in this manner. The Homestead Valve is easily and quickly operated by a quarter-turn of a wrench or a simple lever handle.

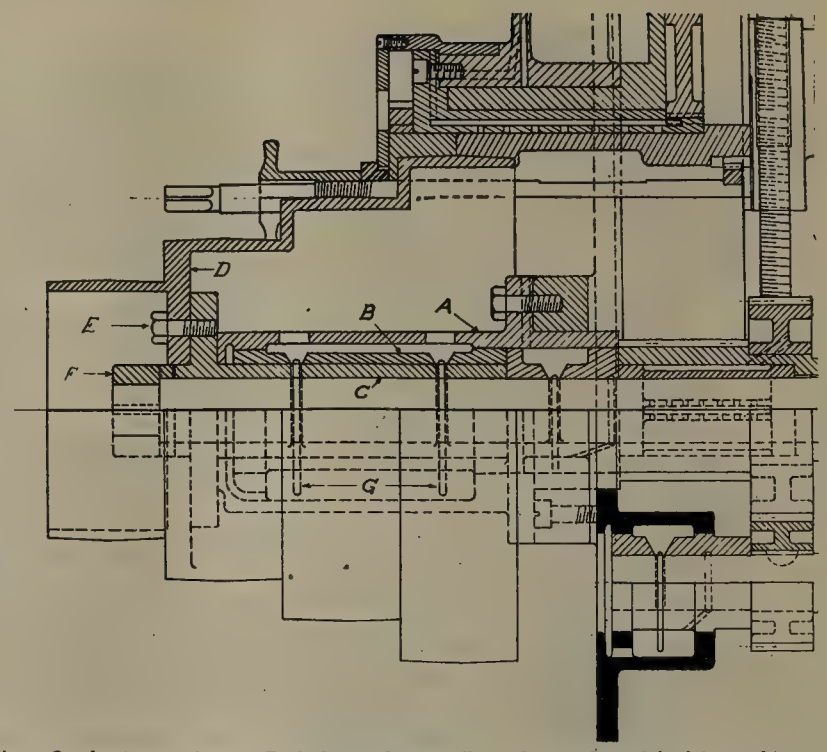


Fig. 2—Independent Driving Cone Bearing, Stockbridge Shaper.

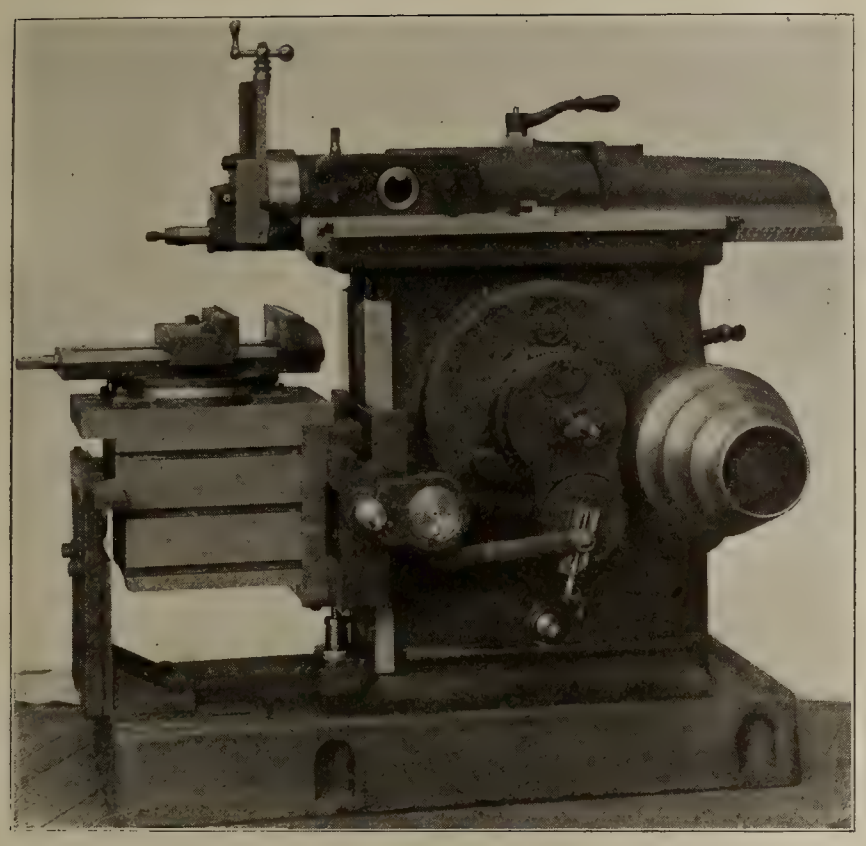
This valve is so constructed that when it is closed the plug is at the same time forced firmly to its seat. This result is secured by means of a patent floating cam fitted to the plug and the cap of the valve. The cam is prevented from turning with the stem by means of lugs which move vertically in slots. If the valve is open the cam will be in the lower part of the chambers on which it is placed and the plug will be free to be easily moved a quarter of a turn for closing, which causes the cam to rise and take a bearing on the upper surface of the chamber. The only effect of further effort to turn the stem in that direction being to force the plug valve firmly to the seat. A slight motion in the other direction immediately releases the cam and the plug turns easily, being arrested at its proper open position by contact of the fingers of the cam at the other end of the travel.

Much of the success of the Homestead valve is due to the workmanship as well as to the quantity and quality of materials used. It is designed not only to meet the requirements of the service and pressure for which it is rated but with a large factor of safety to stand unusual and unexpected strains. They are made for difficult service on water, air or steam lines and for use as float valves. Naturally also they are made to suit all classes of materials to be handled and therefore are of iron, brass, and brass and iron, for flanged and screwed connections in the usual sizes. The advantages of these practical plug cock valves are so great that valve users ought to know how extensively and satisfactorily they may be employed.

NEW 20 INCH BACK GEARED SHAPER.

A new heavy duty shaper has been brought out by the Stockbridge Machine Company, Worcester, Mass. This machine is designed to meet the requirements of the heaviest kind of work that it can be put to. A number of new features have been embodied in this design to meet the requirements of the unusual amount of power which this machine will develop at the tool point.

To protect the shaper against possibility of breakage, a new cross feed has been designed, making it impossible to feed against the cut. This mechanism is illustrated in Fig. 1. A reciprocating motion is imparted to A through the usual type of cross feed rod. The click, B in turn, is moved over the internal ratchet gear C giving to it an intermittent motion. The amount of motion given gear C being determined by the amount of feed which is adjustable. Motion given to gear C is communicated to cross feed screw H either directly through intermediate gear F or through the two intermediate gears F and G. By this means the direction of feed is changed. In order



New Heavy Duty Shaper.

to secure these two positions in a train of gears, the two intermediate gears are supported on a rocker. The rocker may be thrown to either of three positions; one as shown with the handle at D—when feed is direct through gear F; another, by moving handle through an arc of 180 degrees and feeding through the two intermediate gears F and G; when the handle is in 90 degree position—E—gears are in neutral, and yoke L at the same time has been raised sufficiently to throw, automatically, the click B out of engagement with gear C. In this way, all possibility of gears getting caught when changing the direction of the feed is done away with. The saving of time by the use of this feed will be appreciated by every mechanic who has had occasion to use a shaper on work where it was desired to feed across in one direction and then back without having each time to change the cross feed rod or change direction of feed by adjusting screw. With this motion the only operation necessary to change the direction of feed is to throw the handle to one position or the other, which can be accomplished almost instantly and without stopping the shaper.

Another advantage of this motion is that it is impossible for the operator to feed on the cut. By eliminating this possibility there is no danger of broken cross feed parts, since it is the "cut feeding" that sometimes does so much damage.

The base is in keeping with the liberal proportions of the rest of the shaper. Its unusual depth provides metal enough to absorb vibration and gives to it sufficient strength to hold the weight put upon it without springing. This base will carry the knee and knee support with absolute rigidity. The base is slightly concaved on the outside and has a pan cast on the inside, absolutely protecting the floor upon which the machine rests from becoming oil soaked. Oil is drained to a pocket from which it can be drained off.

The driving cone is supported on an independent bearing built out from the shaper column. The belt pull is carried by this bearing entirely, the driving shaft being driven by a two-jaw clutch F, shown in Fig. 2, the driving shaft being carried by an independent bearing. The method of construction as shown—A is the cone bearing which bolted to the column of the machine, B the bushing which slips over this cone bearing and the cone hub C, which fits inside bearing. The cone is indicated as D and is bolted to the cone hub by means of four bolts E. A deep oil well through oil rings G keep bearing flooded with oil. All shaft bearings are bushed and self-oiling.

The shaper is equipped with Stockbridge patented two-piece crank motion, giving a 3:1 quick return.

The crank is provided with a double bearing, eliminating all overhang. The crank, having two bearings, is supported rigidly, maintaining alignment, running with a smoothness which shows in the fine finish to work that can be obtained.

The shaper is equipped with a telescopic screw with ball thrust bearings for raising and lowering the table. The top of the knee is made separate and hooks over the saddle, relieving the knee bolts of practically all strain. The ram can be positioned and adjusted to any length of stroke. Taper packings adjusted from either end by means of screws take up all wear and assure perfect alignment. The table support automatically adjusts itself to any heighths of table and gives a bearing the entire width of table.

Some of the principal dimensions are:

Actual length of stroke	20¾"
Vertical tranverse of table	13"
Cross transverse of table	26"
Greatest distance ram to table	15½"
Diameter of head	8⅝"
Feed to head	9"
Top of table	14" x 20"
Side of table	14" x 15"
Vise opens	13½"
Vise jaws	13½" x 3"
Number of steps on cone	4
Number of speeds to ram, cone drive	8
Number of speeds to ram, gear-box drive	10
R. P. M. of countershaft	350
Total ratio of gearing, back gears	26.4:1
Total ratio of gearing, direct drive	6.6:1
Ratio of cutting and reverse strokes	3:1
Net weight of machine and countershaft	3,750 lbs.
Boxed weight of machine and countershaft	4,100 lbs.

TWIN WATER STRAINERS.

The "Twin" water strainer is a recent improvement in strainers which has been developed by the Elliott Company of Pittsburgh, Pa. It is intended to be placed in a line through which water is conveyed for the purpose of removing any solid foreign substances, and it fills a long-felt need for a strainer that will give a continuous supply of clean water, and at the same time be a device that can be located for convenient operation. When the foot valve strainer, which has been in common use for so many years, becomes clogged, an unreasonable amount of labor is required to remove the obstructions, as the strainer must necessarily be located below the water level, and consequently cannot be properly examined when in operation. The Twin strainer can be placed in any convenient location in the water line, and will work equally well when placed in a horizontal or vertical position, or at an angle.

As its name implies, the Twin strainer is two strainers in

Twin Strainer.

Northern Portable Electric Hoist.

one. The body of the strainer is divided into two compartments, each containing one straining basket. By a simple arrangement of the valves contained in the strainer, the water is caused to flow through one basket, while the other, being out of service, can be removed, cleaned and replaced without interrupting the flow.

Access to the baskets for cleaning is had through the doors on the front of the body. As the idle basket is not under pressure or suction, it can be removed, cleaned and replaced in a few minutes and the door closed, after which the basket is ready for service. On account of the ease and rapidity of manipulation, the twin strainer, having but two valves and two baskets, will handle water containing any amount of solid matter with less labor and attention than any other device of this kind.

For power plants, central stations, railway water service, or in fact for any plant where the supply of water is drawn from nearby lakes, streams, rivers or ponds, the twin water strainer is a protection against shut-downs. The twin water strainer is manufactured by the Elliott Company of Pittsburgh, Pa.

PORTABLE ELECTRIC HOIST.

An electric hoist designed for portable use and for locations requiring the hoist to be suspended by a single hook has been placed on the market by the Northern Engineering Works, Detroit. It can be easily attached to any overhead trolley or crane and can be readily moved from place to place. It is a labor saver in those locations where a hand hoist is now used. Its speed is many times greater than that of a hand hoist of same capacity and it occupies but little more space and uses but little current. It can, where necessary, be provided with a variable speed controller, graduating the speed to suit the character of the service. Either alternating or direct current can be used; direct current motors are completely enclosed.

Since the necessity of portability and compactness somewhat limits the size of the gearing and moving parts, particular attention has been given to their strength and durability, using material which will insure toughness and durability, and confining ourselves to straight standard cut spur gears, avoiding all planetary or worm or bevel gear combinations.

THE BENEDICT CHAIN WRENCH.

There has always been an active demand for a practical pipe wrench capable of gripping pipe of any dimension over the entire circumference with equal pressure and of standing any normal strain without breaking and without distorting or injuring the pipe. This seems to have been fully accomplished by the Benedict Chain Wrench in a manner so simple as to cause surprise that it has not been worked out long since, and its lightness and strength, coupled with the quickness and ease with which it is adjusted to any pipe, makes it an indispensable necessity in any shop or factory.

The wrench consists of three pieces only—the body, chain and springs. The body is of highest grade cast steel; the chain is of highly tempered tool steel, with teeth on the working side. When not in use the spring serves to draw the chain back into the body, entirely concealing it. The spring is not affected in any way by the strain applied to the chain, its function being to pay out and take up the chain only. A slight pressure on the handle in the direction pipe is desired to turn causes the heel of the wrench to fulcrum on the chain, the strain being continuous around the entire circumference, giving a perfect ratchet effect and making slipping impossible.

This wrench is being placed on the market by the Benedict Wrench Co., 143 West Michigan street, Chicago.

RESHARPENING FILES.

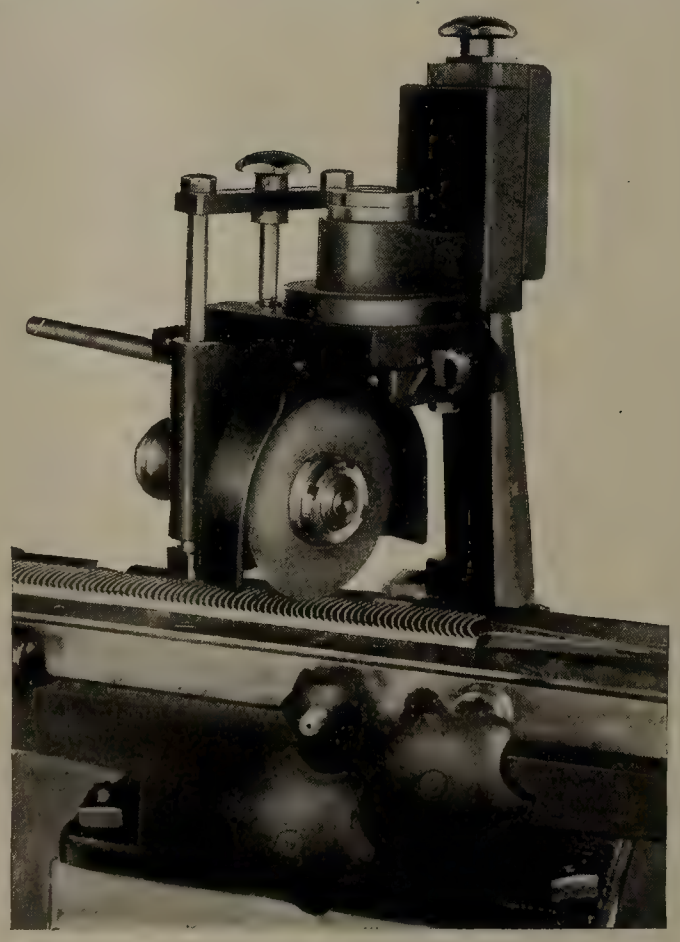
The invention of the milled curved tooth file in 1900 (for which Alexis Vernas of Switzerland was awarded the Elliott Cresson Gold Medal by the Franklin Institute of Philadelphia) was conceded to be the first radical improvement in files for generations.

Almost as important, or probably more important, than this original invention, is the more recent discovery that this curved tooth construction lends itself to a process of direct resharpening, similar to that practiced on milling cutters.

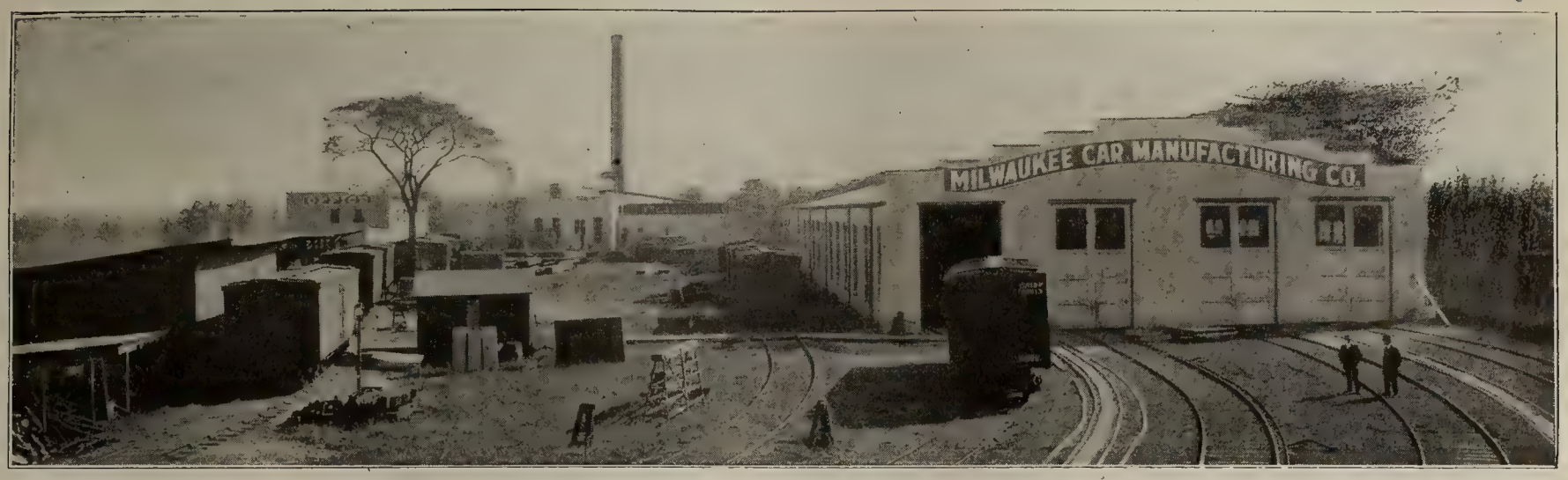
The most striking peculiarity in the construction of the curved tooth file, which is made in this country under the name "Vixen," by the Vixen Tool Company of Philadelphia, is that each tooth is cut separately on milling machines, and it is this process that makes the successful resharpening possible.

Just as each tooth is milled separately in manufacturing, so is each tooth resharpened separately by a fine grinding wheel operating in an arc to conform with the curve of the tooth. The illustration shows clearly all the general details of the Vixen resharpening machine, which takes its name from the Vixen file.

With the left hand the operator swings the wheel around through each tooth separately, while with the right hand the file is moved along from one tooth to the next, as each is resharpened. The wheel directly in the foreground is the one in the operator's right hand, which controls the file, and the lever projecting at the



File Resharpener.



Original Plant of the Milwaukee Car Mfg. Co.

left controls the grinding wheel. The driving belt is removed in this view, but the pulley shows directly below this lever at the left.

One of the most extravagant and wasteful elements of shop practice has been the scrapping of millions of files after their one short life of usefulness. It is hard to estimate the value of a process which makes it possible to extend the life of files from four to six times just as successfully, and in much the same manner as is commonly practiced with milling cutters.

H. W. Marsh,
G. M., Milwaukee Ref. Trans. & Car. Co.

MILWAUKEE REFRIGERATOR TRANSIT & CAR CO.

At no time since the inception of the Milwaukee Refrigerator Transit & Car Co. in 1904 as the Milwaukee Refrigerator Transit Co., has there been any diminution in its healthy progress, particularly since the present management assumed charge in 1910, since which time despite the general depression in all lines of manufacturing, it was found necessary to invest heavily in new equipment, and in 1911, to take over the entire plant of the Milwaukee Car Mfg. Co., and to add car building and car repairing to its established business of operating a private car line of refrigerator cars, in order to meet the demands of its trade. The Milwaukee Car Mfg. Co.'s plant was considered one of the most modern and best equipped of its size in the country and its acquisition proved highly beneficial in many ways, enabling the present company to maintain its full force through a period when others were running slack, which in itself speaks volumes for the class of work turned out, which necessarily must have proved highly satisfactory.

Since enlarging the scope of its operations, the company has turned out all classes of freight equipment, and is giving particular attention to car repairs. The Erie, the Chicago, Rock Island & Pacific, the Escanaba & Lake Superior, and the Standard Car Truck Co., have recently placed large orders with them for equipment of various classes.

The operating department, having charge of the private car line business has kept pace with the other departments in their rapid expansion. The construction and condition of the equipment, which is subject to rental or lease, is the very best, as the company has every modern facility at its shops for keeping it up, and is constantly adding to its present equipment to encourage and stimulate new business.

Present Plant Milwaukee Refrigerator Transit & Car Co.

Recent Railway Mechanical Patents

LOCOMOTIVE.

1,059,378—H. B. MacFarland, Topeka, Kan.

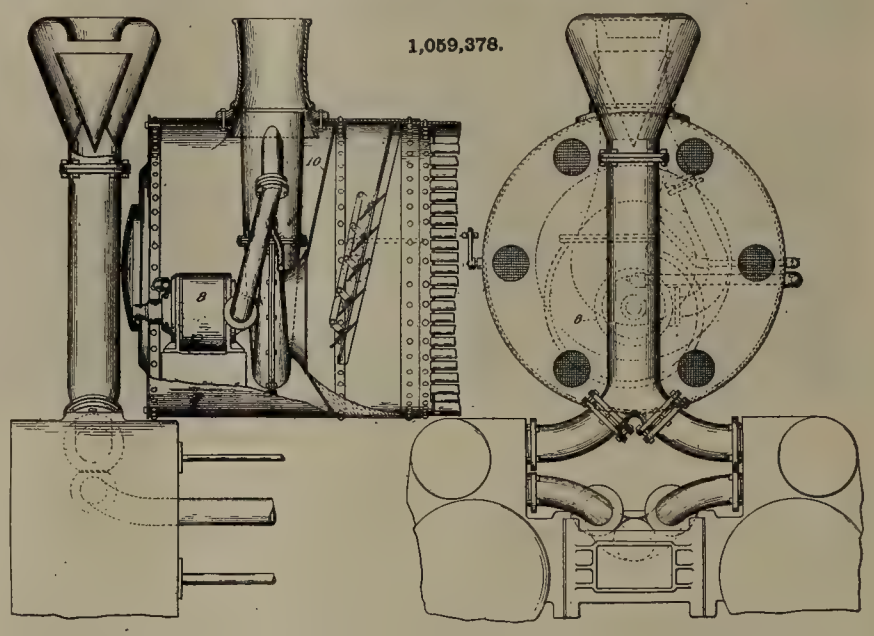
This invention provides for mechanically induced draft. The drawing represents the application to a Mallet compound locomotive. The driving means (8) preferably consists of a steam turbine which is directly connected to a suitable blower or fan of the single suction type for inducing the draft.

The smoke-box is divided into separate compartments by a partition (10) which is intended to be air tight. This partition is provided with a suitable opening arranged at the desired place, which registers with the suction end of the blower. The blower communicates with the smoke-stack by means of a delivery tube, whereby the gases of combustion are ejected from the locomotive. The front end or head of the locomotive may be provided with a suitable number of air inlets or ventilating openings as clearly shown in the end view, thus permitting circulation of fresh air which is taken in through the openings and ejected through the stack, induced by the ejector action of the blower through its delivery tube. By securing a circulation of fresh air through the front end of the locomotive, the temperature therein will be kept at a comparatively low degree and dust and dirt will be prevented from settling into the bearings of the driving means or steam turbine and the blower. There is also a steam jet into the stack for use when the locomotive is being fired.

The exhaust steam from the steam chests is delivered into the branch exhaust pipe, which is located to the exterior of the boiler shell. The exhaust steam, therefore, will be delivered into the atmosphere without passing through the smoke-box or front end of the boiler. The exhaust pipe, if desired, may be provided with a muffler, whereby the noise of the exhaust may be reduced. It is apparent that the exhaust steam from the steam chests of the cylinders is delivered into the atmosphere in such a manner that the back pressure usually encountered while the steam is exhausted into the front end of the locomotive, will be reduced or practically eliminated.

In the compartment between the partition and the front flue sheet is a baffle plate.

1,059,378.



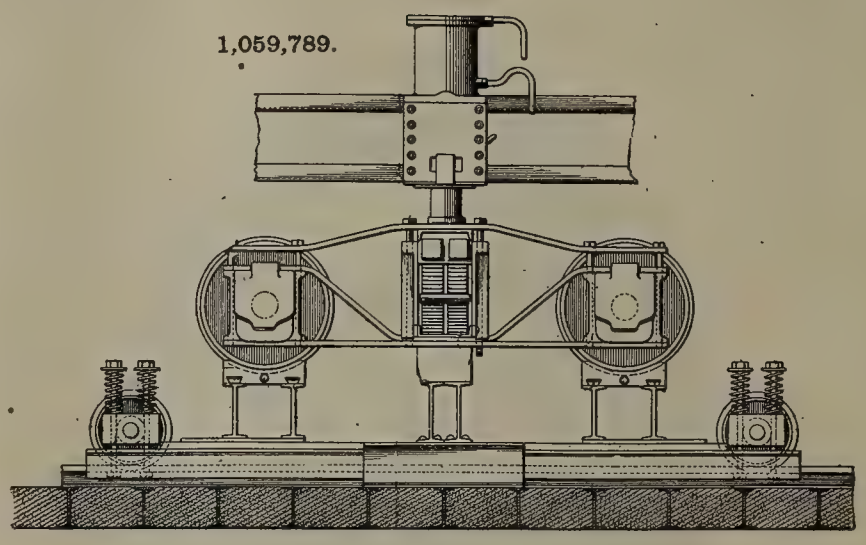
APPARATUS FOR ASSEMBLING CAR-TRUCKS.

1,059,789—Andrew C. Vauclain, of Philadelphia, Pa.

The object of this invention is to construct an apparatus for assembling car trucks in which the springs have to be compressed before the frames are bolted together. In this type of truck the springs are assembled with the bolster and columns and the columns are secured to the side frames after the axles, boxes and springs are in place.

In assembling the truck the axles with their attached wheels are mounted on the blocks, then each lower truss member is placed on a block carried by the beams at the center. The journal boxes are then slipped on the ends of the axles, the diagonal truss members are placed in position, after which the spring plank with the columns and the springs and bolster are placed in position. After these parts are all properly located the upper truss member is placed in position, and the several vertical bolts applied. The assembled truck is then placed under the plunger and this plunger is forced downward, pressing upon the bolster and compressing the springs, allowing the upper truss members to drop into the boxes and the columns. The nuts then are applied so as to hold the several parts firmly together, after which the plunger is released. The truck is then assembled and can be removed from the apparatus.

1,059,789.



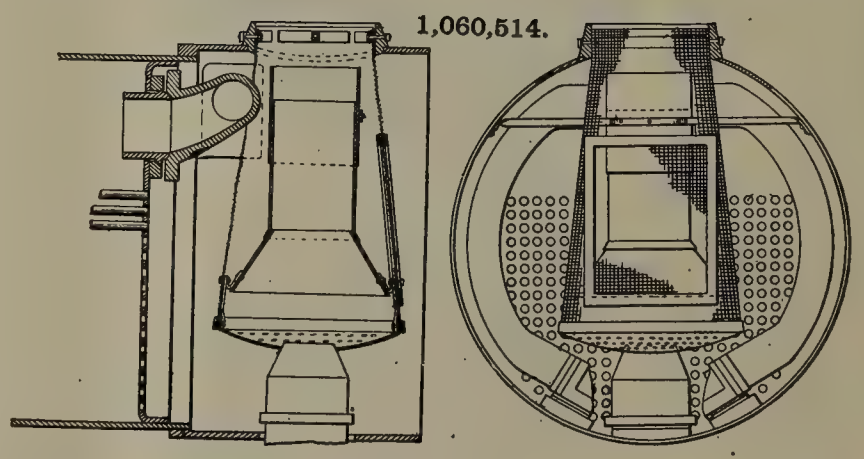
SPARK-ARRESTER AND DRAFT-REGULATOR FOR LOCOMOTIVES.

1,060,514—Frank Tuma, Buffalo, N. Y., assignor of one-half to James C. Currie, Jersey City, N. J.

In this invention a cylindrical or frusto-conical screen of wire netting is used, the upper end of which may be shaped to conform to the inner wall of the smoke stack or its saddle base and is tighly held against the same by means of an internal annular band, preferably made in sections, bolted to the stack base to prevent the passage of sparks or cinders between the wall of the screen and the inner wall of the stack. To the lower end of the screen is secured a perforated metallic plate, the radius of which is made to conform to the radius of the smoke box or arch so as to obtain the best results, and provided with a central opening and adapted to seat upon the tapered end of the exhaust nozzle. Within the cylindrical screen and above the exhaust-nozzle is arranged a draft-pipe, preferably consisting of a number of closely-fitting telescoping sections, the upper section being suitably supported.

The lowermost section carries a flaring mouth-piece which at its widest portion is of somewhat less diameter than the cylindrical screen. Supporting brackets are secured at various points to the flaring mouth-piece.

1,060,514.



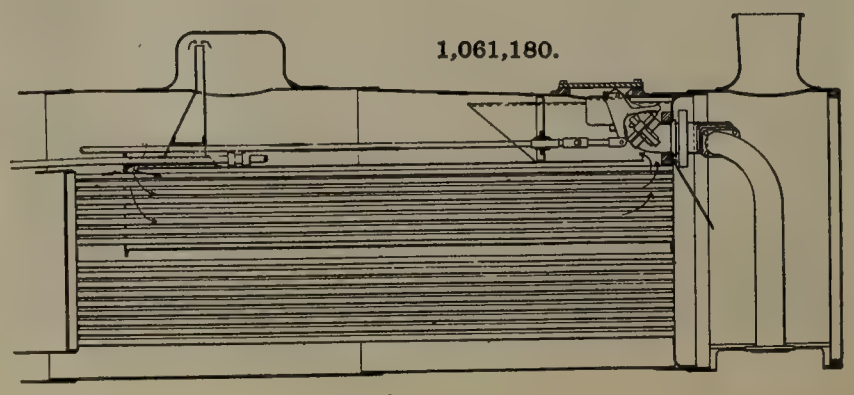
SUPERHEATER FOR STEAM-GENERATORS.

1,061,180—William F. Kiesel, Jr., of Altoona, Pa.

The superheater consists of a shell, composed of a crown piece, slightly convexed, and a bottom piece, of V-shape, the edges of which are riveted to the edges of the crown piece. The shell so formed is of a size sufficient to inclose about one-fourth of the tubes, and extends from the front flue sheet of the boiler to within about one foot of the fire box flue sheet, where the flues pass through the end wall of the shell, the flues at this point being expanded so as to produce practically a water-tight fit. At the forward end the shell is riveted to the front flue sheet of the boiler. Saturated steam passes from the steam dome of the boiler into the superheater through a vertical conduit which rests upon a raised piece riveted to the top piece at the rear end of the shell, and forming a chamber into which an aperture, cut through the end of the top piece, opens. A passageway through the conduit is formed through which the throttle rod and the injector pipe pass.

At the front of the boiler a steam space is formed by means of two longitudinal stay sheets and a cross sheet riveted to the barrel of the boiler, to the front flue sheet, and to the top piece of the superheater. A passageway through the top piece adjacent the front flue sheet leads into this chamber. Within the chamber is located the throttle valve from which the connection leads to the cylinder branch pipes. A damper is hinged above the tubes in the smoke box, and is so shaped as to cover the ends of the tubes which pass through the superheater when in closed position. When the boiler is first fired up the damper will be closed over the superheater tubes, and will remain closed until the locomotive is ready to be attached to a train, to prevent the overheating of the tubes in the superheater. The damper will then be opened and remain open until the locomotive is detached from a train, or is put into the round house.

1,061,180.



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Exhibits Permanent and Temporary

Railway supply and equipment concerns have each year appropriated greater sums for the purpose of exhibiting their product to purchasers, until present expenditure for temporary exhibits is scarcely realized by those who view them and are educated thereby. Temporary exhibits at conventions, while a necessity, are very expensive; and in the fact that in spite of the expense the exhibits still grow in volume, lies the argument of those who urge the permanent exhibit.

In the machinery field there has been maintained a permanent exhibit in the city of Philadelphia. The "Bourse" is an institution of long standing and has reached a degree of success which seems to warrant permanency. The only institution of like nature in the railway field is the "Railway Supply Permanent Exhibit" in the Karpen building, Chicago. This is an institution of comparatively recent inception, but its growth and popularity among those who have benefited by its system seems also to confirm the opinion that the permanent exhibit is a modern need. It does not of necessity form a substitute for convention exhibits except when such conventions are held in the immediate neighborhood, but the argument for convention exhibiting applies in reinforced effect with respect to the permanent exhibit.

Railway officers are not attracted in great numbers to the permanent exhibit at any particular period, but during the course of the year, the number of visitors is perhaps as large as at any convention while there is the advantage to exhibitors, that those who do come are brought by the desire of educating themselves by inspection of the appliances solely. The attraction to the exhibit is magnified by the club facilities in connection and proper management cannot fail but make the permanent exhibit permanent.

An Ignorant Writer to an Uninformed Public.

An understudy of Brandeis, one M. Gesundheit, who claims to have been a "special representative of a committee on efficiency of one of the leading railroad systems of America," writes in the July issue of Cassier's, of waste in the present practices of the railways. As is customary with this class of popular writers, the article criticizes many standard practices in detail, without pointing the way to improvement.

The gentleman mentions several specific illustrations taken from observation for his argument. Several of these are worthy of thought, but he leaves it entirely to the people he criticizes to do the thinking and devise improvement. Attention is called to the modern method of repairing cars in interchange, which involves overlapping bookkeeping, duplicated effort, and unnecessary charges for repairs to foreign cars. He adds "In short the whole system, while an advance over old methods in vogue prior to the M. C. B. Association, is nevertheless fraught with extravagant expenditure and a direct invitation to dishonesty."

Here is a charge which is no less than cowardly, for if the author has any familiarity with the problems he discusses, he knows that this perplexing problem has been studied carefully for years and that every effort is being made to correct it. The implication is, however, that a worthless system is being deliberately maintained. A safe comparison is that with

methods "prior to the M. C. B. Association" as forty-seven years ago there was little interchange.

Another charge refers to railway shop practice in comparison with that of industrial shops, in which the former is made to suffer. It is stated that expensive machine tools stand idle most of the time, that jigs and templates for standard work are not developed, and that where labor saving devices have been put into service in one shop, other shops on the same system have not benefited.

The question of comparative efficiency, considering the railway and industrial shop, is one of personal opinion. Those qualified to speak have in the majority of cases given the railway shop the credit for the most efficient work on jobs which could be considered as standardized. On miscellaneous repair work, fair comparison is impossible. It is, however, true that shop superintendents and foremen should give more attention to applying to their own needs methods successfully used by others and it is believed that the necessity for interchange of ideas is being considered of greater importance each year, as is evidenced in the activity of workers in the conventions of the many associations the like of which cannot be found in the industrial field.

Locomotive fuel expense comes in for its share in Mr. Gesundheit's analysis. He mentions the waste due to improper firing, pilfering, loss on the right-of-way, etc., all of which has been watched as closely as possible by the railway management. He states that little has been done to stop these leaks and that the instruction and supervision of enginemen has only been touched upon superficially. His lack of knowledge of the subject is aptly illustrated by the following which is quoted from his article: "the majority of our railroads have touched it only superficially and contented themselves with the occasional instruction of their train crews by their roadmasters."

We wonder where Mr. Gesundheit found roadmasters instructing train crews and why he does not criticize the system which calls for this extra knowledge on the part of an officer of the maintenance of way department. Seriously speaking, however, there must be further improvement along the lines suggested and, in view of the lack of suggestion on the part of the sensational and destructive criticizer, constructive criticisers must be found and their suggestions for betterment given attention.

Twenty Years Ago This Month.

With this issue we incorporate a feature which we believe will interest young as well as the older officers of the mechanical departments. The important events of twenty years ago in railway work, form history, the perusal of which is instructive as well as of momentary interest. The problems of that date, and the methods of their solution have direct application in the solving of modern problems.

Many of the men now engaged in active work of an executive nature were then in precisely the same position. But the larger number of present day mechanical heads have since arrived. Some look upon twenty years as a short period indeed and in some lines of slow development there has been little change. However, the development in nearly every direction has been so great as to be realized only by scrutiny of the records of twenty years.

This column will be as interesting in the future as our readers make it and the editors expect the assistance of those with good memories in securing the items of greatest importance and interest.

PENNSYLVANIA DINING CAR REGULATIONS.

The Pennsylvania has established a rule which shall debar from employment in its dining car and restaurant department any person with even a tendency toward a communicable disease.

There is to be a quarterly physical examination of every employe who has anything whatsoever to do with the preparation or serving of food. Dishwashers, kitchen helpers, cooks, and waiters, both white and colored, must undergo a rigid examination every three months, and only a 100 per cent report on their physical condition will permit their remaining in the service.

While those suffering from tuberculosis, diseases of the eye or skin, and any other communicable disease, may not be employed in any capacity where they might come in contact with food, the further precaution is taken in debarring them from employment in places where linens and table-ware are kept.

If a Pennsylvania dining car or restaurant employe becomes disabled through any cause, he shall not be permitted to return to work until he receives a "Certificate of Ability" from one of the company's doctors.

In order to surround the service with every possible precaution, there are provided at "lay-over points" for dining car stewards, waiters and cooks, special lodgings with clean linens, clean beds and every sanitary protection. These lodgings are inspected personally by the superintendents of dining cars and restaurants, by service inspectors, and by medical examiners of the company.

CONVENTION OF THE CHIEF INTERCHANGE ASSOCIATION.

An executive committee meeting of the Chief Interchange Car Inspectors & Car Foremen's Association was held at Atlantic City on June 16 to complete arrangements for the fourteenth annual convention to be held at Minneapolis, Minn., August 26, 27 and 28, 1913. The entertainment committee met with the executive committee and its members are as follows: Chairman and assistant treasurer, L. S. Wright, of the National Malleable Castings Co.; secretary-treasurer, W. J. Schlacks, McCord & Co.; R. E. Webb, Galena Signal Oil Co.; E. Walters, American Steel Foundries; J. C. Tawse, American Brake Shoe & Foundry Co.; G. T. Cooke, Chicago Car Heating Co.

Early in July Messrs. F. C. Schultz and J. L. Stark spent two days at Minneapolis making the final arrangements and they returned full of enthusiasm as to the beauties of the city and the arrangements for the convention. They say that without doubt the association is very fortunate in having selected Minneapolis as its meeting place this year. The headquarters of the convention are to be at the West hotel. Among the entertainment features planned are automobile rides on the boulevards and to the nearby lakes, a ride to the bathing beach, an evening enertainment at one of the parks and a trip out to Excelsior on a special train provided by the Minneapolis & St. Louis Railway, where an afternoon and an evening will be spent.

Representative members of the association who attended the mechanical conventions at Atlantic City returned very much pleased with the changes made in the interchange rules, as they obtained many of the changes asked for. The coming convention will be an important one for the association.

Twenty Years Ago This Month

The twenty-seventh annual convention of the Master Car Builders Association and the twenty-sixth annual convention of the American Railway Master Mechanics' Association were held, in 1893, at Lakewood, N. Y. (on Chautauqua Lake). The July, 1893, issue of the *Railway Master Mechanic* devoted much space to a report of these conventions. About seventy members registered at the M. C. B. convention and about one hundred and twenty members of the A. R. M. M. Assn. were present.

One of the important committee reports of the M. C. B. Assn. was that on the application of the standard automatic coupler. The committee consisted of E. D. Bronner, W. H. Harrison, A. M. Waitt, Wm. Garstang, A. Dolbeer and J. H. Davis.

Compound locomotives were considered by a committee of the A. R. M. M. Assn., consisting of Geo. Gibbs, Wm. Lewis, Pulaski Leeds, James Meehan and T. W. Gentry. This committee, with hesitation, tentatively recommended the compound for both passenger and freight service.

The World's Columbian Exposition was being given much attention by railway officers and new developments in railway appliances were interesting exhibits.

In July, 1893, the New York Central had just started a twenty hour service between Chicago and New York. The train was made up of Wagner Co. cars "with vestibules covering nearly the whole platform." Hydraulic buffers were used and the train weighed 200 tons.

It is interesting to note that the coupler problem was attracting the efforts of many of the supply manufacturers who developed the automatic coupler in several different designs. Among those who advertised automatic couplers in the *Railway Master Mechanic* twenty years ago this month were the St. Louis Car Coupler Co., Pratt & Letchworth, McConway & Torley, Buckeye Automatic Coupler Co., Hinson Car Coupler Co., Johnson Car Coupler Co. and the Gould Coupler Co.

Four locomotive companies among eight featured the compound principle in their advertising.

Tests were being made of an axle generating system for car lighting and one writer expressed much enthusiasm over the prospects of the development of a satisfactory system for electric lighting.

A. W. Gibbs, now general mechanical engineer of the Pennsylvania, then master mechanic of the Richmond & Atlanta, was appointed assistant master mechanic of the Pennsylvania.

The first "high speed" electric locomotive was completed in the Lynn works of the General Electric Co. It was designed for a speed of 30 miles per hour. It was placed on exhibition at the World's Fair.

J. W. Duntley, in July, 1893, opened an agency for the Sharon Steel Casting Co., in the Monadnock Block, Chicago.

The Lake Street Elevated Railroad, Chicago, received 20 compound locomotives for passenger service. This order was, in a sense, epoch making, as it marked the first use of compound engines in this class of service.

A "rain maker" with an especially equipped car was sent into Kansas by the Chicago, Rock Island & Pacific.

July, 1893, was a blue month for the mechanical as well as other departments of the railways. Shops were placed on short time or closed. Large numbers of men were discharged. All new work was curtailed or stopped. In addition, a general decrease of 10% in all monthly salaries was simultaneously put into effect by many railways.

By D. R. MacBain.

The "999," the largest and most magnificent passenger engine of the world, was on exhibition at the World's Fair in Chicago. The largest passenger engine in use on the American continent was about one-half the weight of the present-day standard, and had about one-half its hauling capacity.

C. E. Smart, general master mechanic of the Michigan Central, was being quite severely criticised by many operating and mechanical men for his stand on the 10-wheel locomotives for passenger service. Quite a large number of which were then in service on the Michigan Central Railway.

Twenty years ago this month we were all twenty years younger than we are now. We wish this were not true.

VANADIUM SPRING SERVICE RECORDS.

Results of comparative service tests of chrome-vanadium and carbon steel driving and engine truck springs, conducted by the Illinois Central Railroad, showed that the former averaged twice the mileage of the latter, under practically identical conditions.

It was also shown by the records, that because of their longer service, the chrome-vanadium springs saved from 31% in the case of engine truck springs to 54% in the case of driving springs in the cost of springs per unit of service.

With a view of determining the relative strength and endurance of these two types of springs in actual service, careful comparative records were kept by the above road of the length of service, and mileage per spring of a set of chrome-vanadium and a set of carbon steel springs, applied to two 10-wheel locomotives of the same class. All conditions were practically identical. Corresponding springs in the two sets were of the same design. The locomotives were operating on the same division in identical service and tests were made under the supervision of the Master Mechanic of the division.

These comparative records were kept for a period of over a year. They showed that in the case of driving springs, the chrome-vanadium springs averaged 98,428 miles per spring as compared with 41,296 miles for those of carbon steel, or 138% more. In the case of engine truck springs, the mileage per spring was 79,567 and 40,230 miles for the chrome-vanadium and carbon steel springs respectively, or a difference of 93% in favor of the chrome-vanadium springs.

Further analysis of the results shows that while the locomotive equipped with carbon springs broke 3 engine truck springs and 2 driving springs during this period, only one of the chrome-vanadium driving and one of the engine truck springs had failed.

Following the completion of the above comparative tests, further records were kept of the chrome-vanadium driving springs.

The complete records, which covered a period of over 2½ years' service, showed that the chrome-vanadium driving springs averaged over 2 years' service and 146,587 miles per spring. The records of the length of service and mileage of each of the 6 chrome-vanadium driving springs for the entire period during which they were under observation were as follows:

Driving Spring.	Miles.	Length of Service.
Right Front	98,428	14 mo. 22 days
Left Back	138,994	23 mo. 10 days
Left Front	141,597	24 mo.
Right Front	145,411	25 mo.
Right Main	177,546	30 mo. 15 days
Left Main	177,546	30 mo. 15 days
Average per Spring	146,587	24½ months

When the records were finally discontinued, the two original vanadium main driving springs were still on the engine.

For purposes of more complete comparison, records were also kept during the first period of the tests of the service of carbon steel springs on the same class of 10-wheelers, operating on two other divisions.

A comparison between the average service of the carbon steel springs on the three divisions and the set of chrome-vanadium springs up to the time the records were discontinued is given in the following table. This also gives a comparison of the relative cost per spring per 1,000 miles run, based on the average mileage. The records for the carbon steel springs, represent the average for 25 driving springs and 22 engine truck springs. The average results show a saving in favor of the chrome-vanadium driving springs of 16c or 54% per 1,000 miles run and 13c or 31% for the engine truck springs.

The class of 10-wheel locomotives to which the springs were applied had a total weight in working order of 149,700 pounds.

Of this 116,800 pounds was carried on the driving wheels and the remainder on the truck.

	Cost Per Spring Per 1,000 Miles, in Cents. Carbon.	Chrome Vanadium.	Per Cent in Favor of Chrome Vanadium.	Carbon.	Chrome Vanadium.	Saving in Favor of Chrome Vanadium in Cents Per 1,000 Miles.
Driving Springs	42,145	146,587	248	29	13	16
Engine Truck Springs..	34,635	79,569	129	42	29	13

A greater proportion of the track is laid with 85-pound rails, the remainder being 75 and 95-pound rails. Broken stone is used for ballast.

The problem of spring failures is one which is being given careful consideration on the railroads throughout the country. With the advent of the heavy modern locomotive, increased duties have been placed upon the present standard carbon steel springs.

On many roads it has been found that carbon steel springs fail to satisfactorily meet the increased requirements resulting from heavier spring loads combined with high speeds. Spring failures are on the increase. For instance, in the case of one road which has been brought to our attention spring failures have increased to a point where they average as many as 1,000 a month. Nor if other records were available do we think this would prove to be an exceptional case.

In view of the seriousness of the problem, these comparative spring service tests of the Illinois Central are of particular interest. Countless physical tests have proven the higher physical properties of chrome-vanadium springs as compared with those of carbon steel.

The records herein given show the advantages of these higher physical properties in providing a greater margin of capacity with resulting increase in length of service and a material reduction of spring failures.

The dimensions of the springs used in the tests are as follows:

ENGINE TRUCK SPRINGS.

20 Plates, 4 inches wide by ⅜ inch thick.

Distance between centers, free	36¾	inches
Distance between centers, loaded	38	inches
Free Height	12⅝	inches
Loaded Height	10½	inches

DRIVING SPRINGS.

20 Plates, 3½ inches wide by ⅜ inch thick.

Distance between centers, free	35	inches
Distance between centers, loaded	36	inches
Free Height	11⅝	inches
Loaded Height	10	inches

PENNSYLVANIA R. R. Y. M. C. A. BAND.

The Pennsylvania Railroad Y. M. C. A. band of Enola, Pennsylvania, which it will be remembered gave a Sunday concert at the recent mechanical conventions, was organized October, 1909, with 12 members and now has a membership of 45, composed of men working in the shops and yards. The band has filled a number of important engagements for concerts at different places and is a good drawing card for employing and keeping intelligent workmen. The Pennsylvania Railroad Y. M. C. A. is managed by a board of 12 directors, of which C. B. Gray, general foreman of Enola shops, is president; G. W. Fisher, yard master, treasurer, and H. B. Orr, clerk in the foreman of car inspectors' office, secretary. R. H. Barnes is general secretary.

H. G. Hassler, foreman of Enola shops is president and manager of the band, and J. H. Kinter, foreman of car inspectors, is corresponding secretary. There is also a band committee composed of several members who look after the welfare of the band, making a monthly report to the board of directors. George F. Tyrrell, director, is well known as a musician and conductor, and the success of the band is largely due to his untiring efforts, constant attention and energy in its behalf. The requirement for membership in the band is to hold a membership ticket in the Association. The illustration shows the band in the booth of the Buffalo Foundry & Machine Co., on Young's Pier.

Pennsylvania Railroad Y. M. C. A. Band, Enola, Pa.

Report of the Forty-Sixth Annual Convention of the American Railway Master Mechanics' Association.

The forty-sixth annual meeting of the American Railway Master Mechanics' Association was held on Young's Million Dollar Pier, Atlantic City, N. J. President Crawford called the meeting to order at 10 a. m. Wednesday, June 11, 1913, and the meeting was opened with prayer by the Rev. Mr. Cadwell, of Atlantic City. The address of President Crawford followed.

ADDRESS OF PRESIDENT CRAWFORD.

It is with a deep personal appreciation of the privileges and with sincere pleasure that I welcome you to the forty-sixth annual convention of the American Railway Master Mechanics' Association.

The Railway Supply Men's Association has again prepared for your inspection and instruction the splendid exhibit of railway appliances, which we all have become accustomed to regard as a useful part of our convention, and I am told that the number of exhibitors is greater and the space occupied larger than at any previous convention.

While these exhibits are of undoubted value to those attending these conventions, the difficulty in obtaining sufficient space and the expense incident to installation lead me to suggest that the most careful consideration be given by those in authority in the Supply Men's Association to the question of the wisdom of their further extension.

After most careful consideration of the subject at a joint meeting with the executive committees of the Master Car Builders' Association and the Railway Supply Men's Association, it was decided that the entertainment features of this convention be carried out along the same lines as determined upon for the conventions of last year; namely, that the participants bear their pro rata share of the expenses, and that the entertainment be less formal in character than was the practice previous to the 1912 meeting.

In order that the fullest possible opportunity be given for the inspection of the splendid exhibits it was decided to omit from the program the usual ball game, thus permitting the members and guests to devote the entire day of Saturday to the exhibits or to those informal meetings which are so conducive to better acquaintance and, consequently, to the interchange of information, which is difficult to accomplish in the regular sessions. It is sincerely hoped that the entertainment provided will be found agreeable and that everyone present will do their utmost to make this meeting pleasant as well as profitable for one another.

There will be no report this year from a committee on consolidation. After several years' consideration of this subject it was apparent that the majority of the members of the association were opposed to the suggestion. While it is true that after forty-five years of good service it hardly seems wise that the American Railway Master Mechanics' Association should lose its identity, I am compelled to say that a closer working arrangement with the Master Car Builders' Association is desirable, and it is thought that the suggestion made by President Bentley in 1912—namely, that the two associations meet in one week, with a joint session on one day—would probably bring about the desired results without the consolidation of the two associations.

It seems imperative, however, that the Master Mechanics' Association take cognizance of what is being done in the line of work which comes under the supervision of the members of this association, by the General Foremen's Association, Air Brake Association, Fuel Association and the Society for Testing Materials, and to assist as far as possible in making the work of these industrious and capable associations of greater value to the railways and to the public. To this end I suggest that either the Committee on Subjects, or a special committee, review the work done by these associations so that the information obtained may be given to this association, perhaps in the form of an individual paper by a member of the associations named.

Legislative action, both federal and state, continues to occupy the minds of the railway men of the country, and many of the measures under consideration involve the construction, maintenance and operation of railway equipment. J. Ramsey McDonald says, "Legislation must work with life, not try to tyrannize over it, and life is such a confusing welter of interdependent relationships that legislation very often dislodges an evil from one place only to give it abode in another."

The above is particularly applicable to that legislation which tends to produce rules and regulations which are in conflict with well-known physical and mechanical laws, and impose burdens from which proper returns in safety, reliability and economy cannot be obtained. It is important that this association and its members co-operate with the federal, state and other authorities to bring about a better understanding of the limitations in the construction and operation of railway equipment, so that such future legislation as may be desirable will be in accord with the principles of physics and mechanics, rather than tending away from them, as is now too often the case.

Bills have been introduced in the federal Congress and in several states requiring that locomotives be equipped with headlights of high candlepower. I have witnessed several tests of headlights of various intensities, under operating conditions, and cannot refrain from congratulating the association upon its action in the convention of 1912, when you passed the resolution opposing the use of high power headlights on railways with multiple tracks and with interlocking or automatic signals. My observations lead me to fear that extending the use of high power headlights will result in more frequent accidents and, consequently, loss of life and damage to property, the danger increasing in relative proportion to the density of traffic, the number of tracks and signals.

Since the convention of 1912 the engineers' and firemen's requests for wage increases and changed working conditions have been settled by arbitration, the former by a board of seven, with the Hon. Oscar Strauss and Dr. Charles Van Hise, as chairman, and the latter by a board of three, as provided for in the Erdman act, with the Hon. William L. Chambers as chairman. The proceedings of both of these hearings contain much data and information which is of interest and value to the members of this association, and no doubt have been reviewed by all of the members.

During the hearings of the firemen's case frequent reference was made to the proceedings of this association. This should bring home to us the need that the association obtain and promulgate such comprehensive and accurate data on all questions regarding the locomotive and its operation, that its proceedings will be looked upon as the most reliable and authoritative information available on the construction, maintenance and operation of locomotives. It should also provide records of the comparative results obtained with different types of locomotives in different service under the many varying conditions. The desirability of such authoritative information, representing the consensus of opinion and bearing the approval of a recognized organization, will be apparent to all who are familiar with the proceedings of the arbitration cases above mentioned.

A number of books and articles have been published recently on Railway Operating Costs, among these the widely distributed book prepared by Messrs. Suffren & Son, from which I quote:

"The members of the Maintenance of Way Association, of the Master Mechanics' and of the Master Car Builders' Associations are in direct control of 60 per cent of the operating expenses of the railroads they represent, yet the proceedings of their meetings contain no mention of the labor problem. Their entire attention is directed toward the subject of materials——"

"An enormously effective and valuable work could be done through the medium of these associations in the standardizing of equipment. There is no reason why, given reasonable time, a movement for the standardization of equipment could not be carried to its logical conclusion; but for some inscrutable reason the attention of the members has been directed only toward unit designs for small parts. In some instances at least this standardization of parts has been due to the efforts of manufacturers of supplies, rather than the members of the associations."

Also this: "It seems as if the subjects now up for discussion before the various associations of railway officials are inconsequential when compared with the more important problems that have been overlooked."

The writer of the above was evidently not aware that, very wisely, by common consent in this association, and by prohibition of the by-laws of the Master Car Builders' Association, the very complex problems of labor cannot be discussed. As to the suggestion regarding labor, however, I will offer one thought. The increasing demand for labor in this country will cause to continue the influx of emigrants. Indeed, we can look forward to the time when much of the skilled and semi-skilled labor and all of the unskilled labor will be of foreign origin.

The majority of these men are or have the capability of becoming good workmen, but both the employers and employees suffer on account of misunderstandings arising from dissimilar languages. While the situation may be improved by the employment of interpreters, there still remain grounds for suspicion. Therefore, to meet the condition which will become more and more difficult, it would seem wise to encourage the younger supervising officers of the railways to become proficient in one of the foreign languages, preferably Italian. With this accomplishment that confidence between employer and employee which is so necessary to success may be established.

From my experience with the work of the association, I cannot but agree with the writer mentioned, that entirely too much attention is devoted to material and consideration of the locomotive as a mechanical device, rather than as an instrument of transportation. The study of the general proportions, the hauling capacity, the adaptability of machine to specific work, obtaining the maximum output with minimum expense, is of far more importance to the railways and to the public than the study of the smaller details of the machine and the minute variations in the composition of the materials used in its construction.

As to the standardization of equipment, much has already been accomplished; true, largely in the details of construction, but each

detail decided upon holds out promise of more readily reaching an agreement on the larger problems.

The reports of the several committees which will be presented during the sessions, you may be sure, represent the results of careful study of the questions, and I am sure they will receive the most thorough and complete discussion, so that there will be added to the records of the association information of value to all who may have occasion to consult them.

I will not refer to the reports in detail, but desire to call your attention to some points regarding the work of several of the existing committees.

The Committee on Smoke Prevention has before it what is perhaps one of the more important questions under consideration by the railways. The public and the authorities of almost every city, and of many towns and villages, are insisting on the reduction of smoke from locomotives, and in some instances legislation not only requiring the reduction of smoke but compelling its elimination by substitution of electric power for the steam power, is contemplated. It is particularly desirable, therefore, at this time that this subject receive the greatest possible consideration, and that its discussion will bring out all the available information on the subject.

I also beg to suggest that, in view of the importance of this subject, this committee be continued as a standing committee and authorized to confer and co-operate with the many other associations, technical and civic, engaged in the study of the question. In Chicago, Pittsburgh and many other cities, commissions, each with a large staff of engineers, chemists, physicians, etc., are employed in obtaining information and endeavoring to solve the problem, and the experience of our members should be of value in this work.

It is also recommended that the Committee on Specifications for Material be made a standing committee. The Society for Testing Materials has given this subject the most careful attention, but it would seem that the requirements of material for a particular purpose could better be determined by the practical experience of the consumer than by the more or less theoretical consideration of comparative results obtained under test conditions. This committee should, of course, confer and co-operate freely with the committees of other associations, and give them a full measure of the results obtained in practice, so that they can be coupled up with the laboratory observations, thus permitting the promulgation of specifications which will not only cover suitable material, but which will insure uniformity in quality by prescribing adequate and decisive laboratory tests.

The Committee on Minimum Requirements for Locomotive Headlights, after full consideration of the subject, has undertaken a comprehensive series of tests, as well as the compilation of existing information on the subject.

When it was suggested that a committee to report on superheater locomotives be appointed, I remember that it was stated that this subject had been fully covered in previous reports. So far from this being the case, reference to the proceedings of the firemen's arbitration will show that more definite information is necessary and furnish ample reason for reopening this important question.

As future work for the association I wish to suggest the reopening of three subjects which have not only been considered by it but by others. However, when one consults the existing literature, the lack of sufficiently definite information and the conflict of such as is given is apparent.

Undoubtedly the members of this association and the railways would appreciate and find useful more exact and authoritative advice on these subjects.

In 1900 the *Engineering News* published a chart on which there were plotted twenty-one separate formulas for determining train resistance. These formulas gave the seeker of information the choice of resistances at a speed of five miles per hour, or from 2.1 pounds per ton to 8 pounds per ton, and at a speed of sixty miles per hour, or from 6 pounds per ton to 29 pounds per ton. In 1903 the number of formulas had increased to thirty-three, with the same limitations at five miles per hour, but at sixty miles per hour the range had extended to 31.6 pounds per ton. At speeds between five miles and sixty miles per hour the thirty-three formulas gave every opportunity to exercise a wide variance in the selection of a resistance.

During the ten years elapsing from the time of thirty-three formulas to date, many more have been developed, but these, rather than assisting, have rendered it more difficult to make a selection. Indeed, a short time ago, in applying one of the most generally accepted and frequently used formulas to actual dynamometer measurement, the drawbar pull determined by the formulas was somewhat over twice the amount shown by the dynamometer as actually used to move the train at the running speed.

There are much data available, and a committee of this association could obtain much more which would enable it to offer to all interested a method and formula which would be sufficiently accurate to be of practical application and value. Why not establish the American Railway Master Mechanic's Resistance Formula?

At present the railways are giving this subject a great deal of attention, but are using different methods. In the past fifteen years much information has been obtained on this subject, and recently quite a number of highly interesting and instructive articles have appeared on the subject in the technical press.

There is no more important work that this association can perform than to take from the mass of available data, supplemented by such additional records of investigations as may be necessary, and promulgate a thoroughly practical and at the same time an accurate method of determining the hauling capacity of locomotives, and train loading that would be suitable for all kinds of locomotives under the varying conditions of service.

Would it not insure to the railways and the public the possibility of that economical operation so greatly desired, and at the same time add to the honor of the association, to devise and approve a method of operation so logical that there could be no question of its general adoption?

The use of the word "statistics" without giving the statistician his usual rank in comparison with other members of the "Ananias Club," is indeed difficult. I have been so greatly impressed by the use of statistical data by financiers, the Interstate Commerce Commission, federal and legislative committees, arbitration boards and the technical press, that it seems only proper that those statistics which reflect the results of physical action and performance should at least bear some relation to the originating forces and take cognizance of the potential available as well as the results obtained.

The expense of owning, maintaining and operating a locomotive or other power-producing device is much more a function of the potential available than it is of the burden carried. That is to say, the cost of owning and maintaining, and a large portion of the operating costs of a given locomotive, is the same whether the load hauled is one car or fifty.

That the so-called tonnage mileage basis does not adequately meet the situation may be shown by a simple illustration: A given locomotive, with exactly the same interest, depreciation, maintenance, crew, fuel and operating costs, moving one class of cars, will produce on a certain division 168,000 lading ton miles, while with another class of cars, the same potential, and with no difference in expense, 216,000 lading ton miles will be produced. If the weight of the car is included, or the gross ton miles, as is the practice on some roads, the total ton miles would be 262,500 and 285,600 respectively.

While it is true that the averaging of many conditions tends to reduce the effect of such variations, it is desirable that some more logical unit than the lading or gross ton mile be considered for making comparisons of owning and operating costs and performance of equipment.

It is certain there has been and will be many occasions when statistics of this kind, worked up on a uniform basis for all of the railways, would be of service. A committee of this association could perform a useful service by devising such forms of statistics as would meet the requirements of the railways and others interested in their operation.

Another subject which is always before us is that of fuel economy, both as a matter of saving of expense to the railways, and as a conservation of one of the great natural resources of the country. No more important subject could be given the most careful consideration of this association, perhaps of all the most competent to deal with it.

Locomotive testing plants are now established at the Purdue University, University of Illinois, and at the Altoona shops of the Pennsylvania railroad. Such of the information obtained at these plants as may be with propriety made public might well be reviewed by a committee of this association and, with suitable comments and conclusions, included in the proceedings.

To summarize, it is my idea that the proceedings of the American Railway Master Mechanics' Association should be a compendium of the existing knowledge covering the entire subject of construction, maintenance and operation of railway locomotives—steam, electric or any other from which may be devised. For truly we are of those that Mr. Kipling designates as "The Sons of Martha."

"It is their care in all ages to cushion and buffet the shock;
It is their care that the gear engages; it is their care that the switch lock.
It is their care that the wheels run truly;
It is their care to embark and entrain, tally, transport and deliver duly
The Sons of Martha by Land and Main."

REPORTS OF SECRETARY AND TREASURER.

The report of Secretary Taylor showed that the association had a total membership of 1,074, divided as follows: active 1,009, associate 21, honorary 44. The treasurer's report showed a balance of $1,369. These reports were referred to an auditing committee composed of C. H. Rae, E. W. Pratt and J. F. DeVoy. Secretary Taylor stated that in 1891 the association had deposited with the Stevens Institute of Technology $8,000, for which it was privileged to have four students at the Institute yearly, free of tuition. Since that time the association had averaged three and one-third students per year, but the Institute officials had advised that the income from this fund was not enough to support the scholarship and that about $2,000 had accumulated against the account. A committee composed of Angus Sinclair, G. W. Wildin and William Schlafge had been appointed to confer with the authorities on the matter.

The following were elected honorary members: L. C. Noble, J. S. Cook, E. L. Weisgerber, W. D. Morris, A. M. Waitt, E. E. Davis, C. T. McElvaney and E. A. Walton.

The executive committee gave notice of a proposed change in the

constitution designated to restrict the provisions with regard to honorary membership, which is as follows:

"Members of the association, active or associate, who have been in good standing not less than ten years, and who, through age or other cause, cease to be actively engaged in the mechanical department of railway service, may, upon unanimous vote of the members present at the annual meeting, be elected life members. The nominations must be made by the executive committee. The dues of the life members shall be remitted and they shall have all the privileges of active members, except that of voting.

"Members of the association, active or associate, who have been in good standing, may, upon the unanimous vote of the members present at the annual meeting, be elected honorary members."

W. C. Hayes, past president of the Traveling Engineers' Association, was present as a representative of this association and was given the privilege of the floor.

The first report taken up was that on mechanical stokers, read by A. Kearney.

MECHANICAL STOKERS.

Within the past few years marked advancement has been made and there is no longer any question that the stoker is of practical value and a perfectly feasible proposition. Pioneers in the work evidently received but passing encouragement in their efforts, doubtless on account of their being probably less real necessity for anything of the kind in average locomotive service than now exists, and for the further reason that any increase in power by such means was not given particular consideration.

More recent history very strongly points to the inevitable conclusion that the success of the stoker is not exclusively of mechanical interest, but an operating question as well, and much has been due to continued solicitude from the viewpoint of capacity, relative consumption, efficiency and operation.

In all the work and experimentation with the various schemes suggested, two distinct methods or principles for stoking a locomotive still characterize the stage of development. In one the coal is delivered to the fire box over the bed of the fire, not unlike hand-firing, which is generally termed the "scatter" system; while the other delivers the coal up through the bed of the fire from underneath and is designated as the "underfeed" stoker. Both methods have their advocates and strong points of defense. Consequently, having before us the results both types have accomplished, it would be unsafe to conjecture which school will ultimate survive. Probably both will continue to advance, but time only can foretell their fate, and which will in the end prove more economical.

The committee is therefore unprepared to even venture an opinion as to which type of stoker is better, as both have their points of advantage. There seems to have been a larger number of designs of stokers attempted which have had the "scatter" system for their basic principle than those endeavoring to develop the "underfeed" machine, and probably because the inventors have hoped to reproduce hand-firing conditions. Many more types have been worked out than now seem to occupy the field, but those that have lived are constructed upon either the one or the other principle, although they have differed materially in detail from those that now remain on the market, or have possibly reached the commercial stage of development.

Time seems to have resulted in eliminating many stoker designs, reducing the number mainly to the most prominent, namely, the Crawford, typifying the underfeed, and the Street, representing the "scatter" type. There are, however, two other stokers undergoing development, namely, the Gee and the Hanna, both of the scatter design; and possibly there are many other prospective designs or types which have not yet been presented to the railroads.

The stokers which have undergone some development, and may for that matter still be considered (as it is possible their designers are giving them further study with a view of further improvement, etc.), are the Strouse, Barnum, Hayden, Brewster, Harvey, Dickinson, Erie, Hanna, Gee, Crawford and Street.

The stoker situation, as well as your committee has been able to ascertain, is as follows:

Strouse Stoker.

Seventy-six Strouse stokers have been built to date and applied to engines on sixteen different roads, but on April 1, 1913, none were still in service, so far as known. This design of stoker interferes with the operation of the fire door when it becomes necessary to resort to hand-firing. It is one where all of the coal must be shoveled from the tank into a hopper.

Barnum Stoker.

Seven Barnum or C., B. & Q. stokers have been built to date by the Burlington, one being applied to a switch engine, one to a Prairie type road engine, and five to Santa Fe Decapod engines. All of the latter stokers, we are advised, have been taken out of service on account of difficulties experienced in connection with the driving mechanism used with the taper screws in the stoker trough, also on account of the unsatisfactory distribution of fuel where the lower grades of coal were handled.

Hayden, Hayden Modified, Brewster, Harvey, Dickinson and Erie Stokers.

Nothing has been done during the past year with the above stokers. That is to say, none of them have passed from the experimental to the commercial stage. The experimental machines which were applied did not wholly meet the requirements of a stoker as viewed by your committee, in that several materially obstructed the fire door, which would interfere with hand-firing, should such a course become necessary, and the others have not been sufficiently developed.

Hanna Stoker.

Eighteen or twenty stokers were applied to Mallet, Consolidation and Pacific type locomotives on the Queen & Crescent Railroad, but it is our information they have all been taken out of service, in addition to the single stokers which were put on several different roads. The exception to the above is the one machine on the Carolina, Clinchfield & Ohio Railroad, which is still in service. The one on the latter road, we understand, continues to do good work, and the manufacturers promise to bring out another within a very short time, possessing still further improvements.

Gee Stoker.

The Gee stoker is being developed on the Pennsylvania Railroad. Only one of this design has been built to date. It is in service on one of their H-6 Consolidation locomotives and is reported as giving very good results.

Crawford Stoker.

There have been 153 locomotives on the Pennsylvania Lines West equipped with the Crawford double underfeed stoker. There are 140 locomotives on order which will be equipped with the Crawford stoker. The report is that it is probable that larger power built in future will be equipped with this type of stoker. The Vandalia Railroad reports four Crawford stokers in operation, and the Pennsylvania Railroad also has two in service, making a total of 159 Crawford stokers in service and 140 on order, or a grand total of 299 stokers.

Street Stoker.

In May, 1909, a locomotive on the L. S. & M. S. Ry. was equipped with the first experimental stoker of the Street design. In 1910 five more stokers were put in service, three of which were placed on the L. S. & M. S., where the first experimental stoker was operated. In the year 1911 seven locomotives on four different railways were equipped. All of the last seven, with but one exception, were provided with coal crushers carried on the tank, and handled run-of-mine coal. All of the machines, we are told, are still in regular service.

TABLE I.

RAILROADS REPORTING HAVING STOKERS IN OPERATION, TYPES OF STOKERS AND ENGINES TO WHICH THEY WERE APPLIED.

RAILROAD.	STOKERS.		PRINCIPAL DIMENSIONS OF ENGINES TO WHICH APPLIED.							EXPECT TO APPLY.
	Number.	Type.	Type.	WEIGHT. Total.	WEIGHT. On Drivers.	Steam Cylinders. Inches.	Diam. Drivers. Inches.	Heating Surface.	Grate Area.	Tractive Power.	
Queen & Crescent	1	Hanna	Mallet								Re-designed Hanna.
Carolina, Clinchfield & Ohio	1	Hanna	Mallet	342,650	299,250	23 and 35 x 32	57	5,607	78	70,640	One improved Hanna.
New York Central & Hudson River	1	Street	Mallet								
Buffalo, Rochester & Pittsburgh	1	Street	2-8-2	275,000	217,000	26½ x 30	63	3,625	56.4	51,160	Dependent on market for nut and slack coal.
Vandalia R. R.	4	Crawford	2-8-0	240,945	216,450	24 x 28	62	3,839	54.9	45,327	None.
Norfolk & Western	41 (40)	Street	2-6-6-2	405,000	337,300	22 and 35 x 32	56	5,006	72.2	73,000	50 Street and 1 Crawford
	41 (1)	Street	4-8-0	262,000	222,060	24 x 30	56	4,460	45.0	52,457	
Chesapeake & Ohio	54	Street	4-8-2	331,000	241,100	29 x 28	62	4,129	66.7	58,100	No decision.
	54	Street	2-8-2	315,000	243,000	29 x 28	56	4,052	66.7	60,800	
	54	Street	2-6-6-2	400,000	337,500	22 and 35 x 32	56	5,041	72.2	82,000	
Baltimore & Ohio R. R.	50	Street	2-8-2	282,200	223,600	26 x 32	64	3,968	70	54,587	
	13	Street	0-8-8-0	461,000	Frt. 232,700 Rear 228,300	26 and 41 x 32	56	5,578	100	105,000	To 127 engines.
	1	Street	2-8-0	220,370	198,650	22 x 30	60	2,876	57.05	42,168	
Pennsylvania R. R.	98	Crawford	2-8-0	250,500	226,000	24 x 28	62	4,201	55.13	45,400	
	35	Crawford	4-6-2	293,250	189,525	24 x 26	80	5,098	55.4	32,600	
	155 (18)	Crawford	2-8-0	202,000	179,000	22 x 28	56	2,843	49.04	42,000	To probably large power built in future, 140 on order.
	2	Crawford	0-6-0	135,000	135,000	19 x 26	51	1,755	31.54	28,200	
	2	Crawford	Not given.								
St. Louis & San Francisco R. R.	1	Street	2-8-8-2	418,000	360,000	24½ and 89 x 30	57	5,230	75	83,500	None.

In the year 1912, 165 machines of the screw-conveyor type were placed in service—70 on one railroad, 50 on another, 40 on another, and 5 on another. Since January, 1913, 7 additional machines were put in service; besides, orders were placed for 50 more by one of the above roads, and an additional order was placed for 120 by another road. Thus we find that there have been 189 Street stokers applied to locomotives in service and 173 on order, making a grand total of 362.

It is particularly interesting to note that the Crawford and Street stokers, while representing two distinct types, are developing at about an equal rate, judging from the number of machines which have been applied. The Street stoker has been placed on a larger number of roads, while the Crawford stoker, with the exception of two, has been confined to the Pennsylvania system. The two stokers referred to have been applied, one each, to two different railroads.

Of the 38 roads replying to the circular of inquiry issued by the committee, 7 report stokers in operation, ranging in number from 1 to 153, there being a total of 326 stokers reported in operation, of which number we find 159 are of the "underfeed" Crawford stoker, and the remainder, 167, of the "overfeed" or "scatter" type; 2 Hanna, and the rest Street stokers.

In Table No. 1 is shown a list of railroads which report using stokers, furnishing at the same time the number and type of each machine and the principal dimensions of the engines to which applied. An expression was invited concerning any further application of stokers, which was replied to as shown.

Checking the number of stokers reported as being in service, we find they include about 189 of the Street pattern. This figure was secured from the Locomotive Stoker Company, and as but 165 are shown by the reports from the different roads, we conclude there are some roads using the stoker who have not replied to the circular.

The committee has been able to secure but very little information concerning the actual and detailed operation of stokers from roads where they have been installed in any considerable number; however, the reports we have been able to secure have been put together, as shown in tabulated form. While the information is quite limited, it will no doubt be of some interest.

TABLE II.

Performance of the Crawford Double Underfeed Stoker on the Pennsylvania Lines West of Pittsburgh, Including All Trips of All Stokers from the Experimental Installation to February 28, 1913.

Coal Fired by Stoker in Per Cent of Total Coal Fired.	Number of Trips	Per Cent of Total Number of Trips.
100	19,475	61.0
99	280	0.9
98	416	1.3
95–98	1,530	4.8
90–95	1,847	5.8
85–90	680	2.1
80–85	903	2.8
75–80	1,209	3.8
70–75	379	1.2
Below 70	5,191	16.3
Total.....	31,910	100.0

Table No. 2 gives a rather comprehensive idea of the success with which the Crawford underfeed stokers have been operated on the Pennsylvania Railroad. The tabulation covers the performance of the stokers with respect to handling fuel. Up to February 28, 1913, the stoker-fired engines had made 31,910 trips. Of this total number of trips, 19,475, or 61 per cent, were 100 per cent trips; that is to say, trips on which the stoker handled practically all of the coal which was placed in the fire box. In comparison with this, we find that only 16.3 per cent of the total number of trips were below 70 per cent stoker-fired. The table also shows the number of trips which were partially successfully stoker-fired, which should not necessarily be considered a poor performance. This information, while serving to show the operation of the stoker, unfortunately does not give the cost of maintenance and the character of its failures.

Table No. 3 has been prepared to show the performance of the Street stoker on Mallet engines of the Norfolk & Western and Chesapeake & Ohio Railways. The Norfolk & Western Railway, upon the receipt of forty Mallet locomotives, all equipped with the Street stoker, instituted a systematic record for stoker data, so as to show their complete performance, their failures and responsibility, and cost of repairs, separated for labor and material, both for the stoker as well as the brick arch with which the engines were also equipped. This table, as will be seen, also shows the total number of engine days, or days the engines have been in and out of service.

Taking the average performance of the Mallet engines on the Norfolk & Western Railway up to February 1, 1913, it will be observed that the average number of failures per month was four and a half, and the average mileage per stoker failure was 11,679 miles. The average mileage for failures other than those attributed to the stoker was 3,527 miles. The record shows 23.2 per cent of the total failures were attributed to the stokers.

Another item of interest to which attention might be directed is the cost of stoker and brick arch repairs per thousand miles, which, as will be noted, averages $5.34. The Chesapeake & Ohio Railway furnishes data showing the performance of fifty-four stoker-fired engines, covering a period of three months, namely, November and December, 1912, and January, 1913. The average mileage per stoker failure is found to be 4,474 miles, which is lower than the reports received from the Norfolk & Western Railway. It will also be noted that the average cost for repairs per thousand miles is higher than indicated in the report from the Norfolk & Western, which might be a natural consequence, since the stoker failures were greater in number per miles service.

The committee sought to establish some data to show the relative fuel consumption in hand-firing as compared with the operation of the stoker, but there seems to have been very little reliable information so far obtained. The St. Louis & San Francisco Railroad has furnished a comparison of the coal consumption of the Mallet locomotive hand-fired versus stoker-fired, the runs being made over a district of 119 miles. The report shows that there were a number of delays occurring during the test runs which might to some extent affect the figures.

The information as presented indicates higher economy with hand-fired locomotives. They show an average evaporation of 9.13 pounds of water per pound of coal for four trips, while the stoker-fired engine gave an equivalent average evaporation of 7.88 pounds of water per pound of coal for five trips. No information is given bearing upon the quality, character or heat value of the fuel used during the test, hence it is to be supposed that it was the same for the two tests.

General opinion seems to indicate that there is still some uncertainty as to any saving being accomplished in fuel. Some roads report that hand-firing, if properly executed, shows economy over stoker-firing; while there are just as many ready to report that the stoker has the advantage; then there are also others who regard it as a stand-off in coal consumption.

It is held by some who have been quite close to the work that under similar conditions there is some economy in fuel to be found with the stoker-fired engine, possibly 5 per cent, and this would seem quite logical, because it is conceded that the stoker burns a better fire, with the scatter type running from 4 to 6 inches in depth, as against 18 or

TABLE III.

Performance of Mallet Engines Relating to the Operation of Street Stokers on Norfolk & Western Ry. and C. & O. Ry.

ON NORFOLK & WESTERN RY

Month.	Engine Days.			Engine Failures Attributed to Stokers.							Monthly Engine Mileage.	Average Mileage per Stoker Failure.	Average Mileage per Failure Other Than Stoker.	Stoker Repairs Included in Repairs to Stoker Engines. Brick Arch Repairs Included.					Brick Arch Repairs Included in Repairs to Stokers.			
	Total in Month.	Out of Service or in Hands of M. P. Department.	In Service or in Hands of C. T. Department.	Improper Handling.	Lack of Lubrication.	Hidden Defect.	Machinery or Fresh Break.	Shop Fail.	Clogged with Wood Bolts, Etc.	Total.				Labor in Dollars.	Material in Dollars.	Total in Dollars.	Accumulated Total. Dollars.	Cost of Stoker and Brick Arch per 1,000 Miles. Dollars.	Labor in Dollars.	Material in Dollars.	Total in Dollars.	Accumulated Total Dollars.
1912.																						
April..	52	12	40								4,885	No failures.	4,835	$ 9.57	$ 0.15	$ 9.72		$2.01				
May..	408	142	266	4			2	1	1	8	27,029	3,378.6	1,287	188.85	8.53	197.38	$ 207.10	7.30				
June..	150	134	316								32,046	No failures.	2,670.5	178.88	21.80	200.68	407 18	6.26	$ 3.60	$19.82	$23.42	
July..	465	117	343	1			1		2	4	34,624	8,656	5,770.6	149.17	30.41	179.58	587.36	5.18	.25	.28	.53	$23.95
August.	465	116½	348½								37,309	No failures.	4,145.4	185.99	111.53	297.52	884.88	7.97	4.53	11.33	15.86	39.81
Sept..	457	118½	338½		1					1	37,988	37,988	4,748.5	176.47	30.32	206.79	1,091.67	5.44	2.60	9.54	12.14	51.95
Oct..	895	278½	616½	2	1			2		5	63,888.12	12,777.7	4,914.4	234.59	35.49	270.08	1,361.75	4.22	1.41	4.12	5.53	57.48
Nov..	1199	372	827	4	1		1		1	7	84,983	12,140.4	5,665.5	403.62	72.21	475.83	1,837.58	5.60	3.44	.10	3.54	61.02
Dec..	1240	429	811	2	1		1	2	2	8	89,698	11,212.2	2,718.1	415.06	73.63	488.69	2,326.27	5.45	3.22	6.43	9.65	70.67
1913.																						
Jan..	1240	433	807	1	3	1	4		3	12	113,163	9,430.2	3,650.4	365.49	115.15	480.64	2,806.91	4.25	6.86	10.39	17.25	87.92
Total..	6871	2152½	4718½	14	7	1	9	5	9	45	525,563			2,307.69	499.22	2,806.91			25.91	62.01	87.92	
Avg..	68711	215.25	471.85	1.4	7	1	9	.5	9	4.5	52,556.3	11,679.2	3,527	230.77	49.92	280.69		5.34	2.59	6.20	8.79	

ON ENGINES OF THE CHESAPEAKE & OHIO RY.

1912.																						
Nov..										18	87,416	4,856				$ 655.36		$ 7.50				
Dec..										33	121,269	3,675				745.88	$1,401.24	6.20				
1913.																						
Jan..										27	140,275	5,195				748.86	2,150.10	5.30				
Total..										78	348,960					2,150.10						
Avg..										26		4,474				716.70		6.16				

20 inches hand-fired. Furthermore, with the stoker the fire door is kept closed and the combustion must necessarily be more complete.

A saving in fuel, it would seem, can be expected, not only in quantity but in the grade it is possible to use with the stoker. Generally speaking, the best results seem to be obtained with the smaller sizes of fuel; in fact, with the scatter type machine, slack or crushed coal is necessary, and probably it can be used equally well with the underfeed machines; but the report is that the Crawford stoker has to date been giving good results with small lump coal. With improved combustion, coals lower in heat value (consequently cheaper in price) can be utilized, adding still further to economy conceded the stoker.

It has been observed that when starting out steam can be gotten up quickly, and probably with advantage as compared with hand-firing.

It seems to be admitted by even expert firemen who have had some years' experience hand-firing that they have derived valuable information in hand-firing after handling the stoker and closely watching its operation. With a more perfect combustion there is naturally some reduction in the emission of smoke, or unconsumed carbon, and it is also reported that where the stoker is properly handled it becomes necessary to use the fire hook but very little, if any, on the road, all of which should mean something in the direction of economy.

With reference to the character of coal used on stoker-fired locomotives, we find quite a variety of grades have been reported. In order to compare the different grades, Table 4 has been prepared, but comments seem quite unnecessary, as a glance at the information is sufficient to show that the successful operation of the locomotive stoker as reported does not seem to be confined to any particular grade or character of fuel.

It is unfortunate that it has been impossible so far to secure definite data for the relative consumption of fuel with the stoker as compared with hand-firing. There are, however, some very elaborate tests under way, but they have not progressed sufficiently to justify reliable conclusions.

stoker is capable of handling heavier tonnage, no road is ready to name the amount. Probably if such information had been secured, it might have proven to be widely different on the several roads on account of the existence of widely different operating conditions. The stoker, it is generally believed, is capable of firing a larger amount of fuel and still retain uniformity in its work, from which it follows that higher boiler power is reasonably sure, unless there is a failure from some other cause, but this increased capacity would not be shown in the starting of the locomotive. On the contrary, higher steam pressure maintained would result in higher tonnage, speed if desired, or more work performed by the locomotive.

On some roads where peculiar physical characteristics prevail with respect to ruling grades, etc., it might mean that an engine could be safely given a larger tonnage than had previously been handled, where the ability to start the train from the usual stopping points had not been a controlling factor in determining the tonnage rating.

Therefore, the question resolves itself to one where each road is better able to work out for itself the question of using the stoker with any return after taking into consideration the physical characteristics of the road, size of engines, tonnage now being hauled, and what advantages might accrue. The question is rather one where it must be decided, first, if a more uniform rate of steaming is needed, and what expenditure might be warranted to secure such a condition.

Since with the scatter type of machine the arch brick is regarded as essential, and possibly of equal advantage in other types in the ratio of an engine with or without an arch hand-fired, it would seem its use may be a prime consideration, since it would seem to have a specific value.

A superheater can be introduced, carrying with it some 10 to 15 per cent improvement in fuel or steaming capacity; and if still further advantage is desirable and the quality and quantity of fuel to be fired becomes a factor, the use of the stoker will be felt in the production of a uniform steam pressure, with possibly some saving in fuel where

TABLE IV.

Railroad.	Kind of Coal Used on Road.	Per Cent of Ash.	Difference in Coal Used on Stoker-fired and Hand-fired Locomotives.
C. C. & O. Ry.	Bituminous, coking	7½ to 8	Same coal used in each case.
Vandalia R. R.	Indiana, semi-coking, Illinois coal of poor quality	8 to 12	Same coal when Indiana coal is used. No Illinois coal used on stoker-fired engine.
C. & O. Ry.	Run of mine and nut and slack coal, some coking and some non-coking	12 to 15	Same coal used in crusher type stokers. Picked, special coal used in conveyor type.
B. & O.	Non-coking	10	Non-coking coal used in stokers and coking coal used in hand-fired engines.
Pennsylvania Lines	Non-coking bituminous from Indiana, Illinois, Pennsylvania and Ohio districts	6 to 16	Same coal used in each case.
B. R. & P. Ry.	Very good quality of coking coal	9 to 11	Nut and mixture of nut and slack, sometimes very fine slack for stokers. Run-of-mine used for hand-fired engines.
St. Louis & San Francisco R. R.	Non-coking		Same coal used in each case.
Norfolk & Western Ry.	Run-of-mine bituminous	7 to 10	The run-of-mine coal is screened, the fine slack used on stokers, the lump on hand-fired engines.

The relation of the stoker installation to the amount of tonnage handled, as against hand-firing, was also sought, and in reply to this query, roads using the stoker have expressed themselves as follows:

The Carolina, Clinchfield & Ohio Railway reports heavier trains hauled, but does not say to what extent.

The Vandalia Railroad reports their stoker-fired engines consume about the same time on the division, but that a more uniform steam pressure is maintained.

The B. & O. Railroad reports that it is possible to haul heavier trains with the stoker engines.

The Pennsylvania Lines West of Pittsburgh report 15 per cent more tonnage hauled with stoker-fired engines on slow freight and on long, heavy grades.

The Buffalo, Rochester & Pittsburgh have not observed any difference between hand-firing and stoker operation.

The St. Louis & San Francisco Railroad reports better performance with stoker-fired engines, stating that some firemen are not able to keep up steam on heavy trains on the long runs.

The Norfolk & Western Railway has not recognized any difference in tonnage rating between hand-fired and stoker-fired engines, since with but one exception all of their stokers are applied to one type of locomotive. It has been observed, however, that with the stoker operated properly the locomotive can be worked to its maximum capacity without any marked effect upon the steam pressure, which is a distinct advantage.

The Virginian Railway report has some improvement in steaming capacity and tonnage hauled, but does not give amounts.

A review of the reports clearly indicates that while all concede the the conditions are equal, or higher steaming capacity with higher speed.

Where it is possible to keep the fire door closed, it must follow that the temperature in the fire box is more uniformly maintained, which in turn must result in better service conditions for the fire box, flue sheet and seams, otherwise our theories fall flat. As a matter of fact, observations, though limited, seem to indicate that the life of the flue is being increased, and equal results must necessarily be in store for the flue sheet and the fire box generally, but some allowance should be made for what is accomplished by the arch brick.

Very successful results can be obtained in the operation of the stoker, but some intelligence is necessary to make sure that it is allowed to work efficiently, and one of the most important features to be observed is to prevent the engine from continually popping off, wasting steam and fuel; but even this can be controlled, simply by the manipulation of apparatus requiring no other energy than ordinary attention. No particular effort, as a rule, is required to keep the stoker properly adjusted, working regularly, and free from clogging or disturbance to the uniform supply of fuel to the fire box. In the event of a failure of the stoker mechanism, the fireman, as a rule, can do but very little, except to resort to hand-firing, bringing the engine into terminal, where repairs can be made.

In handling stoker locomotives at terminals, or at ash pits along the road, there is some time to be saved, as the thinner fire can be knocked out or cleaned within ten or fifteen minutes' time, as against probably twice the delay in handling a locomotive which has been hand-fired.

There is no doubt that the maintenance of the stoker, by reason of its increased amount of machinery and working parts, is going to

represent an item of repairs; and even if it has been rather low, as has been shown, some alteration in the figures is likely to take place as the stokers become older. It is also true that as the machines are improved and more substantial parts are applied, and greater proficiency in their manipulation is attained, there should be a corresponding improvement in the cost of maintenance. However, such items, including the time required to turn, repair and otherwise put engines in shape for further service, should receive due consideration in summing up the net advantages derived by the stoker in service.

Reflecting for a moment upon the apparent work and interest manifested in the locomotive stoker, it is believed we must necessarily conclude that although the stoker has not been developed to a state of perfection, it has not only proven to be practical, but has demonstrated by service and endurance tests that it is of value and that there is a growing field for its use.

In concluding, your committee wishes to show as a feature of this report what they conclude are some of the requirements which should and, in fact, are being met in the satisfactory locomotive stoker.

1. It should convey coal from the tank to the fire box with the minimum of physical work on the part of the fireman.
2. It should maintain a maximum steam pressure on the locomotive, and have a margin for additional feeding capacity.
3. It should leave the fire box door and deck, as much as practicable, unobstructed.
4. It should maintain an ideal fire for economic fuel consumption.
5. It should distribute fuel in the fire box in such a manner as to reduce to a minimum any necessity for disturbing the fire by means of the hook.

Committee: A. KEARNEY (Chairman), J. A. CARNEY, GEORGE HODGINS, J. M. JAMES.

Discussion.

W. C. A. Henry (Pennsylvania)—We have made some tests comparing locomotives fired with a Crawford stoker with hand-fired engines. Run-of-mine coal was used, the locomotive being of the Consolidation type, with a tractive effort of 42,600 pounds. We found that the stoker-fired locomotive gave about a 10 per cent greater drawbar pull. This was because of the fact that the stoker could deliver more coal into the firebox than the firemen could. On one of these trips we got a combustion rate of 7,146 pounds per hour.

Table 2 on page 5 of the report is the average of all reports since the first stoker was built, and you know successful trips were exceptional at first. There is no question that the stoker will haul heavier tonnage unless limited by the grade—probably about 15 per cent more tonnage. It will also decrease the smoke one-third.

E. W. Pratt—I would like to hear from the speakers as to the attitude of the firemen.

J. T. Carroll (B. & O.)—We have 73 engines equipped with stokers, 13 of which are Mallets, and are getting good service from them.

M. D. Franey (L. S. & M. S.)—Our experience has been limited in recent years. The stoker is capable of doing the work, but requires some expert attention, and it is possible to get 100 per cent efficiency from it if properly looked after. The stoker we have had experience with is satisfactory and will do a little more work than the ordinary fireman.

M. A. Kinney (Hocking Valley)—We purchased six Mikados awhile ago equipped with Street stokers and had trouble at first, due to the quality of the coal. We had a large amount of coarse slack which must have treatment, and clinkering occurred at the start. There was no particular difference between hand- and stoker-firing. Our experience as to the mechanical maintenance of the stoker agrees with the committee report. The enginemen have given the best co-operation and we are getting first-class efficiency with the stoker from the coal we are able to procure.

D. R. MacBain (L. S. & M. S.)—The stoker is coming mighty fast and at the end of four years more it will receive more consideration than it is receiving now.

Angus Sinclair—When I first fired on a locomotive there was only a reverse lever, a throttle lever and a gauge glass. Everything has developed into success against prejudice. Recently I rode on a freight train weighing 3,500 tons, which ran 50 miles per hour, and I noticed the very good results obtained from the stoker.

F. F. Gaines—The people working on the stoker deserve a great deal of credit, and there is no doubt that the stoker is bound to come. Six years ago on our road the tonnage was controlled by the ability of the firemen to put in coal, but now with larger grate areas and superheaters we are getting along better and burning less coal. These improvements will draw a well-defined line between the stoker and hand-fired engine.

C. F. Street—We asked the firemen on the Norfolk & Western how they liked the stoker, and they said, "It is the fireman's friend." We are now trying to find out why certain variations occur with stoker firing. The physical characteristics of the coal and its preparation is a matter of great importance.

D. Petrescu (Roumanian Govt. Rys.)—Coal is very high in my country and we must use it efficiently. We need big engines, but we could not run them with hand-firing, so we adopted the locomotive stoker and have been able to save 25 per cent in the cost of fuel with the big engines equipped with stokers.

D. F. Crawford (Pennsylvania)—The development of the stoker on the Pennsylvania was brought about by the desire to get more tons per train, as heretofore this had been getting smaller as the engines grew larger. We are building 110 locomotives in which we have increased the diameter of the cylinder 2 inches, and the first of these will be out this week. With the stoker we can supply the coal necessary to take care of this increased diameter. Personally I do not put much store on tests, but like to take the average results of the year. The difference in the mileage made by the stoker locomotive as compared with the hand-fired is inappreciable. From our records, I think the stoker locomotive made perhaps 100 miles per month more. The question is not what are the firemen going to do with the stoker, but what are we going to do with it.

C. F. Street—Unless we put "miles per hour" in the coal record it is of no value. The stoker takes coal, but it gets trains over the road, and train dispatchers are among the strongest advocates of the stoker.

Alex. Kearney—The fuel we are using is close to being powdered, but is high in heat value.

C. D. Young (Pennsylvania)—We are at present arranging to make some tests of powdered fuel, the results of which are to be used in connection with boiler design. The preliminary experiments are to be made on a locomotive boiler with forced draft, erected as a stationary plant.

Two or three years ago it was a question as to whether the stoker would work; now we want to know what economy it effects. We have done some work at the testing plant, and in our opinion the underfeed stoker is as efficient as most firemen. We made some tests with scatter type stokers, but the results indicate that they do not evaporate as much water as skilled hand-fired engines. I think the greatest development of the machine is with powdered fuel.

REVISION OF STANDARDS.

After reviewing the present standards, recommendations, recommended practices and resolutions of the association, and after considering the few replies from members to the circular of inquiry, the committee would report as follows:

STANDARDS.

Screw Threads, Bolt Heads and Nuts.

The committee would recommend the following changes in proportion of hexagon bolt head:

PRESENT PROPORTION.	PROPOSED PROPORTION.
Rough head = 1½ dia. of bolt + ⅛.	= 1½ dia. of bolt.
Finished head = 1½ dia. of bolt + $\frac{1}{16}$.	= 1½ dia. of bolt — $\frac{1}{16}$.
Rough head = ¾ times dia. of bolt + $\frac{1}{16}$.	= ¾ dia. of bolt.
Finished head = dia. of bolt — $\frac{1}{16}$.	= ¾ dia. of bolt — $\frac{1}{16}$.

A member suggests that the table on page 292 be made one of the series of standard plates instead of being contained in the text. The committee concurs in this recommendation.

Castle Nuts, Cotter Pins and Location of Cotter Pinholes in Projecting Bolt Ends.

A member suggests that the insert between pages 292 and 293, showing dimensions of castle nuts, etc., be made one of the series of standard plates instead of being contained in the text. The committee concurs in this recommendation.

A member suggests that on the insert the wording "Plate 4-A" in the upper left corner, the word "recommended" in the heading of the table of dimensions and the table at the bottom headed "Dimensions Obtained from Formulas" are simply parts of the original committee report and should not be contained on the plate. The committee concurs in this recommendation.

Gauges for Cast-iron Wheels.

A member calls attention to the fact that the wheel defect gauge, maximum flange thickness gauge and method of gauging are all grouped under one head in the text, and since each one is a separate standard it should be recorded separately under its own heading. The committee concurs.

A member suggests that the maximum and minimum flange thickness gauges shown on plate 14 should be changed to agree with the gauges adopted by the M. C. B. Association in 1912. The committee concurs in the recommendation.

Section of Tire.

A member calls attention to the title of Fig. 1, which reads: "For Engine and Tender Trucks and Flanged Driving Wheels in Switching Service," and suggests that it should read, "For Steel and Steel-tired Engine and Tender Truck Wheels and Flanged Driving Tires in Switching Service." The committee has noted the correction and instructs the secretary to make the change.

Specifications for Iron Locomotive Boiler Tubes.

A member calls attention to the requirement in paragraph 2 that tubes must be within .01 inch of the thickness specified, and suggests that owing to the difficulties of manufacture of the larger sizes of tubes especially, that this limit be raised.

A member suggests that this gauge limit be made 10 per cent on all sizes of tubes.

A member refers to the requirement in paragraph 6, Expanding Test, in which the tube must stretch to 1⅛ times its original diameter without splitting or cracking, and suggests that this requirement be increased.

These suggestions were referred to the committee on specifications for materials used in locomotive construction.

Specification for Seamless, Cold Drawn Steel Locomotive Boiler Tubes.

A member recommends that the chemical requirements as given in paragraph 1 be changed to:

Carbon, maximum	.15 per cent
Phosphorus, below	.04 per cent
Sulphur, below	.045 per cent

instead of

Carbon	.15 to .20 per cent
Sulphur, below	.03 per cent
Phosphorus, below	.03 per cent

A member calls attention to the requirement in paragraph 2 that tubes must be within .01 inch of the thickness specified, and suggests that owing to the difficulties of manufacture of the larger sizes of tubes especially, that this limit be raised.

A member suggests that this gauge limit be made 10 per cent on all sizes of tubes.

A member refers to the requirement in paragraph 6, Expanding Test, in which the tube must stretch to 1⅛ times its original diameter without splitting or cracking, and suggests that this requirement be increased.

These suggestions were referred to the committee on specifications for materials used in locomotive construction.

Specifications for Steel Blooms and Billets for Locomotive Forgings.

A member recommends that in revising the records the chemical analysis for steel billets, grade B, as shown in paragraph 5, be corrected to read: Carbon .45 to .55 per cent instead of .35 to .50 per cent.

The recommendation was referred to the committee on specifications for materials used in locomotive construction.

Specifications and Tests for Cast-Iron Wheels.

A member calls attention to the fact that the specification for cast-iron wheels calls for a minimum weight of 600, 650 and 700 pounds respectively, while Plate 14 calls for a minimum weight of 615, 665 and 715 pounds, and suggests that the entire specification should be changed to agree with the M. C. B. Association specifications.

The committee notes the inconsistency and recommends the adoption of the M. C. B. Association specification for cast-iron wheels.

A member suggests that the specification for cast-iron wheels should include the 70-ton wheels now being furnished by various manufacturers. The suggestion was referred to the committee on engine tender wheels.

Standard Method of Conducting Efficiency Tests of Locomotives.

A member suggests that the Standard Method of Conducting Efficiency Tests of Locomotives, which was adopted in 1894 and has not been revised in any detail since that date, needs considerable revision and alteration to make it applicable to present-day practices.

The committee concurs in the recommendation and would recommend that it be referred to a special committee for reporting.

Axles for Locomotive Tenders.

A member suggests that the standards should include a 6 by 11 inch journaled axle as it is now being used considerably. The committee concurs in the recommendation and suggests the adoption of the M. C. B. Association axle E:

Specifications for Iron Axles.

A member recommends dropping these specifications from the standards. The committee concurs in the recommendation.

RECOMMENDATIONS.

Allowances of Engine Mileage.

A member calls attention to the second paragraph of the recommendations adopted in 1872, which recommendation is not now in general practice and should be dropped from the records.

"That for engines running local freight trains an allowance of 6 per cent to the train mileage be added for switching." The committee concurs in this recommendation.

A member calls attention to the third paragraph of the recommendations adopted in 1872, which recommendation is not now in general practice and should be dropped from the records.

"That where engines run empty to exceed one-half mile between where trains are taken or left and the roundhouse, such mileage should be computed, and that for engines running through freight or passenger trains no computation should be made for switching." The committee concurs in this recommendation.

General Questions Regarding the Use of Air Brake and Train Air Signal.

A member suggests that inasmuch as the subject of air brake and train signal instruction is receiving detail and special attention on all roads, and the general subject is frequently changing, these recommendations should be dropped from the records. A second member suggests that since the records have not been revised since 1904 they should be revised at once by a joint committee of the M. M. and M. C. B. Associations to bring them up to date. The committee would refer the two questions to the convention for action.

RESOLUTIONS.

A member suggests that in accord with present practices the word "all" should be inserted in the second Resolution of 1886 before the word "flues" making the resolution read:

"Resolved, That it is the sense of this convention that in practice it is unnecessary to bead *all* flues in the front end." The committee concurs in this recommendation.

A member suggests that in view of the present federal regulation as to Safety Appliances, the Resolution of 1888 regarding steps on pilots should be dropped from the records. The committee concurs in this recommendation.

A member suggests that the Resolution of 1899 regarding the instruction required on brake operation and maintenance can consistently be withdrawn, in view of the present practice of railways. The committee concurs in the recommendation.

A member suggests that, inasmuch as no railways include the weight of the locomotive in ton-mile statistics and very few railways include the tonnage of the caboose, the second Resolution of 1902 should be dropped from the records. The committee concurs in the recommendation.

A member calls attention to that part of the Resolution of 1906 which states that $100 should be the limit distinguishing between running and shop repairs and suggests that in view of the present state of the act this figure is very low. The committee concurs in the recommendation and would refer it to the convention for consideration.

NEW BUSINESS.

A member suggests the adoption of standard dimensions for flange couplings for injectors, as such couplings have begun to supersede the older forms of screw couplings. The committee concurs in this recommendation and suggests that it be referred to a special committee with instructions to cover the subject of screw couplings as well.

A member recommends for adoption as a standard of the United States Safety Appliance Standards which apply to locomotives, as contained in the order of the Interstate Commerce Commission dated March 13, 1911. The committee concurs in this recommendation.

A member recommends for adoption as a standard of the Federal Regulations for the Inspection and Testing of Locomotive Boilers and their Appurtenances as contained in the order of the Interstate Commerce Commission, dated June 2, 1911. The committee concurs in this recommendation.

A member recommends for adoption as standard of:

(a) Specifications for rolled steel wheels as adopted by M. C. B. letter ballot 1912 or specification for solid wrought steel wheels.

(b) Rotundity gauge for steel wheels.

(c) Plane gauge for steel wheels.

(d) Gauge for measuring thickness of rim.

(e) Method of branding steel wheels.

The committee does not concur in this recommendation.

A member recommends for adoption as a standard the M. C. B. limit gauges for remounting cast iron wheels, as shown on M. C. B. Sheet 16-A, revised in 1912. The committee concurs in this recommendation.

The committee desires to call the attention of the Association to the comparatively few replies to its inquiries as made by circular. With an active membership of more than one thousand, but twenty replies were made. Of these twenty, there were five who made no reply to the direct inquiry as to the extent to which the standards were used. The remaining fifteen indicated an adherence to the standards in all details of from 25 per cent to 100 per cent, very few following in full the specifications as given for materials, alterations more or less extensive being indicated in most cases. It is also noted that out of the full membership only 180 voted the "Letter Ballot" and several standards were adopted on the approval of only one-eighth of the membership. The committee, therefore, recommends that:

(a) For the purpose of developing and shaping standards to a suitable form for universal adoption by the members, the Association should have and use "Recommended Practice."

(b) No standard should be adopted until it has been a recommended practice for at least one year.

(c) A standard should require such a substantial approval of the full active membership and the full railroad representative membership on the basis of one additional vote for 100 locomotives represented as will insure its being generally used.

(d) Whenever the Association deems it advisable to alter any present, or prepare new specifications for material in which other recognized societies are interested, that the committee in charge of the work should be instructed to request the co-operation of those societies in preparing the specifications.

Committee: W. E. DUNHAM (Chairman), M. H. HAIG, A. R. AYERS.

Discussion.

F. F. Gaines moved that the items referred to the convention by the committee be turned over to the incoming executive committee. Carried. He also moved that the items suggested by the committee for letter ballot be so referred. Carried.

J. F. DeVoy (C., M. & St. P.): I would like to know why the specifications with regard to cast iron axles were dropped by the committee. We object to having them dropped, as we want the privilege of using them in case of necessity.

W. E. Dunham (C. & N.-W.): Iron axles are not being bought at the present time.

F. F. Gaines (Cent. of Ga.): I move that the 6 inch by 11 inch journal box be adopted as recommended practice. Carried.

THURSDAY, JUNE 12.

The first report taken up was that on "Specification for cast steel locomotive frames."

SPECIFICATIONS FOR CAST STEEL LOCOMOTIVE FRAMES.

In 1904 there was submitted to the Association the following specification far cast steel locomotive frames, as suggested by the committee of steel-casting manufacturers.

MATERIAL.

Carbon	.28
Phosphorus	.05
Sulphur	.05
Manganese	.60

Frames will be rejected that show:

Less than .20 or over .35 carbon.
Over .06 phosphorus.
Over .06 sulphur.
Over .70 manganese.

Tensile strength per square inch, not less than 55,000 pounds.

Elongation in 2 inches, not less than 15 per cent.

All frames to be annealed.

The committee was appointed to ascertain whether these specifications were entirely satisfactory, and if not, what changes should be made to make them so.

The committee has found in its investigation that there is still considerable difference in opinion among railroad officers, steel manufacturers and locomotive builders in regard to the chemical and physical requirements for cast-steel locomotive frames.

Carbon.

The 1904 specifications require the carbon content to be .28 per cent, and while it is very common practice to still make frames and other locomotive steel castings from a .25 to .28 carbon steel, the experience of many of our members and some of the manufacturers indicates that better results are obtained if frames are made from a .37 to .40 carbon steel. This gives an increased stiffness and higher elastic limit. Of course, the ductility is reduced, but if the frames are properly annealed a high carbon content should give much better results on the heavy power used to-day.

The tests of low carbon steel frames of recent manufacture show carbon content ranging between .24 and .30, with an average of .273.

The tests of high carbon steel show carbon between .39 and .42, with an average of .405.

Phosphorus and Sulphur.

The 1904 specification requires the phosphorus and sulphur content to be .05, with .06 as rejection limit. The general consensus of opinion among all manufacturers and users is that the rejection limit should be changed from .06 to .05. From the large amount of data available to your committee, the phosphorus content of frames of recent manufacture ranges between .037 to .048, with an average of .0443, and the sulphur content ranges between .022 and .043, with an average of .0305.

Manganese and Silicon.

The manganese content in the old specification was .60, with a rejection limit of .70. It is the usual practice to-day to accept material having .70 of manganese and .20 of the silicon, but it is not the usual practice to specify limits for either of these elements in recent specifications for steel. Manganese usually ranges between .50 and .70. Silicon usually ranges between .24 and .28.

Tensile Strength.

In the matter of tensile strength there has been a great change since 1904. The specification of that date recommends not less than 55,000 pounds tensile strength. All specifications which have been examined call for not less than 60,000 pounds tensile strength, many call for 65,000 pounds, while some call for 70,000 pounds to 80,000 pounds. Many tests in the hands of your committee show tensile strength from 75,000 to 80,000 pounds, and quite a number of them run as high as 85,000 pounds.

Elongation.

The 1904 specifications require an elongation of not less than 15 per cent in 2 inches. The usual practice at the present time is an elongation of 20 per cent in 2 inches. As the carbon content of steel is increased the tensile strength is increased, but the ductility is decreased, and perhaps a better rule to follow is "the per cent of elongation in 2 inches shall not be less than 1,200,000 divided by the tensile strength." For steel of 60,000 pounds tensile strength, this gives an elongation of 20 per cent. For steel of 75,000 pounds tensile strength, the elongation would be 16 per cent.

Annealing.

The usual practice in annealing frames is to apply heat slowly, so that all castings in all parts of the furnace are heated to a uniform temperature of 1,500 degrees, after which the furnace doors may be opened and the furnace and contents allowed to cool.

Vanadium.

The committee has not deemed it advisable to submit a standard specification for vanadium steel frames at this time.

The following specification for cast-steel frames is recommended:

1. Castings must be true to pattern and free from flaws, shrinkage cracks, excessive scale or porosity. When patterns are furnished by a railroad company the manufacturer must make sure that the allowances for shrinkage in the patterns agree with his own practice, and castings will be rejected, even when made from railroad company's patterns, which do not conform closely to required dimensions. Frames must be made perfectly straight and in true alignment, both vertically and horizontally. Frames will not be accepted which weigh less than 97 per cent of the weight specified, and material in excess of 6 per cent above the specified weight will not be paid for. The specified weight must allow a proper amount for finish, as may be agreed on.

2. All castings must be thoroughly and properly annealed, and test pieces must be annealed with the castings before they are detached.

3. Test pieces shall be 1 inch square, and, when possible, 10 inches long, and must be left attached to each frame. At least two test pieces, one near each end of the frame, shall be provided. The test pieces shall be partly sawed off from the body of the casting so that they can be easily broken off, but shall not be entirely detached by the manufacturers. Both the main casting and test pieces shall be stamped with heat numbers. The finished test pieces for tensile strength test shall be ½ inch in diameter and 2 inches between shoulder fillets.

4. The material desired has a tensile strength of at least 70,000 pounds per square inch; elongation, 20 per cent in 2 inches, and an elastic limit of 50 per cent of the tensile strength.

5. Cast-steel frames will be rejected which show less than the following requirements:

Tensile strength, minimum.....65,000 pounds per square inch
Elastic limit, minimum.....30,000 pounds per square inch

Elongation in 2 inches shall not be less than a percentage represented by 1,200,000 divided by the tensile strength.

Reduction of area, minimum	30 per cent
Phosphorus, maximum	.05 per cent
Sulphur, maximum	.05 per cent

When high carbon steel frames are specified, the carbon content must be not less than .37 per cent and the reduction of area not less than 25 per cent; other requirements as above.

Committee: C. B. Young (Chairman), E. W. Pratt, R. K. Reading, O. C. Cromwell, C. E. Fuller, L. R. Pomeroy.

Discussion.

G. W. Wilden (N. Y., N. H. & H.)—I move that the report be referred to letter ballot. This motion was carried.

MAINTENANCE OF ELECTRIC EQUIPMENT.

By C. H. Quereau.

It is the intention not to stray into the pastures of the electrical engineer or indulge in speculations as to the advisabiilty of electrifying steam railroads or attempt arguments in defense of any particular system, single-phase, three-phase or direct current Such discussions have already been vigorously carried on, with more or less success and satisfaction, by those much better equipped for such contests than the writer. As a result, noncombatants have reached the practically unanimous conclusion that "Time alone will settle the case."

We all recognize the fact that several important steam railroads have, to a limited extent, replaced steam locomotives with electric locomotives and multiple-unit cars; and that their successful operation for five or six years and the experience gained during this time makes the subject of the maintenance of electric equipment a live one. The fact that at least six American steam railroads are now using electricity for motive power purposes and the recent announcements of plans for extensive electrification of main lines on western steam railroads suggests the thought that almost any steam motive power organization may be called upon at an early date to maintain electric motive power and should make this subject of interest to all steam motive power men.

The word electricity naturally raises in the mind of a steam motive power man a suggestion of mystery, something he knows little or nothing about, and, what is worse, he is very apt to conclude he is "too old to learn." It is the object of this paper to try to show there is no more mystery about electricity than about water, steam, coal or other gifts of nature about which motive-power men have enough knowledge and familiarity to successfully manage their work; if possible, to remove the natural, but useless, fear of the subject which most of us have.

Until about seven years ago, I had no practical knowledge of electricity or experience with electrical apparatus, having held the positions of engineer of tests, division master mechanic, superintendent of shops and assistant superintendent of motive power with steam railroads. This statement is made for the purpose of showing that the point of view of the paper is that of a steam motive-power man and with the hope it will make what follows more convincing than otherwise would be the case.

When asked to take the position of superintendent of electric equipment, my first and very strong impulse was to decline because of lack of electrical experience, nor did the statement that all the expert electrical talent necessary would be supplied entirely remove the dread of entering the—to me—mysterious and untried field of electric traction. The assurance of the head of the railway department of an important manufacturer of electrical apparatus that at least 75 per cent of the necessary training was supplied by experience in mechanical lines, did little more than somewhat reduce the distrust and the feeling that the field of electric traction was full of pitfalls and blind

alleys. The experience of a few years has shown that the electrical expert was conservative and that at least 90 per cent of the problems of maintenance to be solved and the faults to be remedied can be successfully worked out by a good mechanic, with a very limited electrical knowledge, who has had experience in the motive-power department of steam railroads.

To those acquainted with the men who are responsible for the maintenance of electric equipment—whether on trolley, interurban or steam railroad lines—it is a matter of common knowledge that those master mechanics, general foremen and mechanics who have been trained in the motive power departments of steam railroads have somewhat the advantage of those who have not. I have in mind a western mechanic and general foreman whose experience with electric equipment was limited to six months as electric inspectors' helpers, who are eminently successful in maintaining electric equipment. In the case of steam railroads which are electrified, there are decided advantages in using men already in the organization whose characteristics are known, who are familiar with steam railroad policy, methods and requirements and such a plan removes all ground for the possible feeling that electrification will crowd out of their positions men who have served the railroad faithfully and satisfactorily for years. Some knowledge of electricity for such men is certainly necessary, but is very elementary and simple, preferably practical rather than theoretical, and can be acquired in such a short time that the advantages of using men for the maintenance of electric equipment who are already in the steam motive power department very decidedly outweigh the disadvantages due to lack of an extended knowledge of electrical apparatus. This conclusion has been reached after six years' experience in an electric equipment maintenance department on a steam railroad.

I am inclined to believe the greatest bugaboo for the steam motive-power man, when considering electrical matters, is the fact that he is not familiar with electrical terms and therefore imagines the whole subject is difficult. When the uninitiated hears or reads of volts, amperes, watts and kilowatts, circuit breakers, contactors and other electrical terms, he finds these words as meaningless as so much Choctaw. As a consequence, he gets no real information or adequate conception of the subject discussed and, perhaps naturally, concludes it must be beyond his powers and altogether mysterious. A little reflection will show him that at one time he was equally ignorant about such common-place matters as hydrostatic pressure, steam consumption, horse-power, air brakes and superheaters, and that in all probability it would puzzle him, after years of practical use, to accurately define these terms, or even explain to a visitor from Mars what a foot really is, though for all practical purposes he knows each of them thoroughly and never imagines his inability to define technically the words he uses almost hourly is any handicap in successfully holding his job.

The volt is defined as "The practical unit of electromotive force which will cause unit current to be established in a circuit of unit resistance," but for all practical purposes may be considered as the unit for expressing the pressure or tension of an electric current, just as the pound is the unit used in expressing boiler pressure.

There is no doubt arising in the mind of anyone as to the meaning of the sentence, "The boiler carries a pressure of 100 pounds," nor is it necessary to be precise and add, "per square inch," because constant use has made us familiar with the meaning of the statement without looking in a book or stopping to think. We know that, other conditions remaining constant, steam at a pressure of 200 pounds will do twice the work that steam at 100 pounds pressure will. In the same way, a little practice will enable us to understand offhand there is twice the power in a 200-volt current there is in a 100-volt current, because the former has twice the electric pressure of the latter. When we become familiar with the fact that the usual voltage of the electricity used about the home for lighting purposes is 110 and that the usual voltage for trolley and interurban, as well as multiple-unit, electric cars, varies from 500 to 600, we have a working basis from which to understand the statement that a transmission line is designed for 11,000 volts and a very large part of the wonder and mystery disappears.

With the above statements thoroughly fixed in our minds by constant use, if we read that the Puget Sound Lines of the Chicago, Milwaukee & St. Paul are planning to electrify several hundred miles of its lines, using a voltage of 2,400, instead of wishing we had learned something of electricity when we were younger, we understand they are considering the use of an operating current having a voltage or pressure four times that which is usual.

The ampere is defined as "the practical unit of current and represents that value of current which will cause the electrolytic deposition of silver at the rate of 0.001118 grams per second." For everyday use, we may think of the ampere as the unit for measuring the quantity of electricity used or available, just as we speak of pounds of steam or gallons of water, and will know at once that an electric motor using 200 amperes of 600-volt current has twice the power of one using 100 amperes of current at the same voltage, or half the power of a motor using 400 amperes and a voltage of 600.

The watt is the unit of electric power and, for all practical purposes, is the product of the pressure, or voltage, by the quantity or amperes. For instance, the power of a current of 600 volts and 250 amperes is $600 \times 250 = 150{,}000$ watts. The watt in electric power matters is used in the same way that the term horse-power is in connection with steam power. It is reasonable to believe that anyone who can understandingly use the word horse-power in speaking of steam motive power can become accustomed to the intelligent use of the term watt, and when he learns that 746 watts are equal to a horse-power, can, with a little practice, compare the rated power of an electric motor or generator and a steam engine.

A kilowatt is simply a thousand watts and the term is used only for convenience. In the preceding paragraph mention was made of an electric current having a power of 150,000 watts. This is usually referred to as a current of 150 kilowatts, or simply 150 k.w. From what has been said, it is evident a kilowatt is almost exactly equivalent to one and one-third horse-power and a 150 k.w. current equals practically 200 horse-power.

The terms watt-hour and kilowatt-hour are used in connection with electricity just as horse-power-hour is used in steam motive power discussions and means electric power of a watt or k.w. used, or available, for an hour.

The ohm is the unit expressing the resistance of a conductor to the flow of electric current and "represents the resistance of a column of pure mercury 106.3 centimeters long, of uniform cross-section and weighing 14.451 grams, at a temperature of zero degrees, centigrade."

It will take but little practice to understand the statement that a conductor having a resistance of 5 ohms will carry twice the current that a circuit having 10 ohms resistance will, or half the current a circuit having 2½ ohms resistance will carry, assuming that the voltage is the same in each case.

I have previously stated that "Some knowledge of electricity . . . is certainly necessary, but is very elementary and simple, preferably practical rather than theoretical." In this connection it should not be forgotten that this paper relates to the maintenance and is not concerned with the design of electric equipment. Experience has shown that the graduate in an electrical course who is employed in maintaining electric apparatus is apt to require wiring diagrams and blueprints showing the circuits and relations of the apparatus, while the inspector whose training has been wholly practical soon learns by precept and practice that a given symptom is caused by a given defect and does not find it necessary to trace the intermediate steps, but goes at once to the seat of the trouble and removes the cause. For instance, when an electric locomotive loses power when the motors are operated in series parallel, after having operated satisfactorily in series, the embryo electrical engineer is prone to waste time in hunting up wiring diagrams and tracing circuits, while the inspector whose knowledge has been acquired by practical experience knows that either a certain fuse has blown because of an overload, or a certain contactor has failed to operate properly and at once applies the necessary remedy.

It would be unwise to assume from the foregoing that an elementary knowledge of electricity and the ability to read wiring diagram blueprints are undesirable or unnecessary to anyone employed in the maintenance of electric equipment. Such knowledge is both desirable and necessary, just as much as for steam equipment, but no more. The point is that the average mechanic, without previous electrical experience, does not require any great amount of electrical knowledge in order to successfully compete with an electrician in maintaining electric motive power.

The average nontechnical reader has no doubt been mystified by the terms "series" and "series-parallel" and figuratively thrown up his hands. If to these is added "full parallel" he is probably down and out, but for one who is willing to try, their meaning is as plain and easy to understand as the terms "simple" and "compound" or "mallet" applied to steam locomotives.

Most electric locomotives have as many as four motors. When the electric current passes through these motors one after another, as shown in the accompanying diagram, the motors are said to operate in series, the circles representing the motors, the lines with arrow points representing the path of the electric current.

When the circuits are arranged so that the current passes through two groups of motors, each group consisting of two motors, they are said to be operating in series-parallel, or series-multiple; that is, two motors are operating in series in each of the two groups, while the two groups of motors are operating in parallel, or multiple; the current supplied to one group of motors flowing parallel to the current supplied to the other group.

If now each of the four motors receives its supply of electricity direct, that is, without flowing through any other motor, the motors are said to operate in full parallel, or simply in parallel, the current to and through each motor flowing parallel to that of each of the other motors.

It will not be surprising if some reader is unable to understand the diagrams representing the different groupings of motors. They will probably be readily understood if the circles are supposed to represent water motors—water turbines for instance—and the lines with arrow points are assumed to be a diagram of the water pipes, the arrows indicating the direction of flow.

This brings to mind the fact that the most helpful illustration to an understanding of electric circuits and diagrams is to think of them as showing a water system. In place of the electric motor put a water

motor, and consider the wiring plans as showing the distribution and connections of water pipes. The analogy can be carried farther; the water pressure stands for the voltage and the pounds or gallons of water flowing or available, the amperage of electric current; the horse-power hours of a water turbine are the equivalent of the kilowatt-hours or horse-power hours of an electric motor or generator.

It is not the intention to write an elementary treatise on electricity or electric apparatus nor promote a dictionary of electrical terms with nontechnical definitions, but simply to give assurance to the average motive-power man that his experience, together with a very elementary electrical knowledge, qualifies him for the maintenance of electric equipment. In addition, it is hoped the bugaboo of imaginary mystery surrounding electrical matters will lose most of its terrors.

In addition to the cloud of mystery, there is quite generally an exaggerated fear of electricity in the minds of the uninitiated—a fear of personal injury—that prevents them seriously considering the advantages and wider opportunities in the electric-equipment department. That there are advantages and wider opportunities there is little room for doubt. This fear is doubtless in part due to the fact that lighting is generally known to be of electrical origin and to the further fact that electricity can not be seen, as steam and fire can.

A child is not encouraged to play with matches or fire in any form, nor anyone without experience to assume responsibility for steam apparatus. The same precautions used in connection with electric matters will assure as small a percentage of injuries and fatal accidents. Life insurance companies charge no higher premiums for men working about electric equipment than those employed in ordinary repair shops for steam equipment.

The fact is, if simple and inexpensive precautions are taken, there is no greater danger in working about electric than steam equipment. No one with ordinary sense and experience would think of putting his bare hand on the unprotected steam pipe of an injector, even though he can not see the steam flowing through it. There is no greater danger in connection with electric circuits if the same common sense is used. This refers to 600-volt direct current and would possibly have to be modified for materially higher voltages, or to high-tension lines where the hazard is undoubtedly greater.

The statement is occasionally made that an electric is a simpler machine than a steam locomotive. If this refers to ease of handling and operating or matters requiring the attention of the engine crew, such as injectors, steam pressure and water level, there is no possible doubt the statement is correct, but if it refers to the mechanical simplicity or number of adjustable or moving parts that must be inspected and kept in proper relation, the steam locomotive is very much the simpler. There is, however, this fundamental difference favoring the electric machine; that the moving parts of the control are of very light weight, easily accessible for inspection and repairs and not subjected to nearly as great wear as are the corresponding parts of a steam locomotive.

It will no doubt interest motive-power men to know that the shop arrangement and tools for maintaining electric equipment are not essentially different from those they are accustomed to in repairing steam locomotives, except, of course, the electric locomotive has no boiler or tender and it is necessary to provide facilities for rewinding armatures and field coils.

The steam motive-power man will no doubt be much surprised when told the electric locomotive requires no shopping for a general overhauling, except for a general painting. This is made possible by having a stock of spare parts, permitting the removal of a defective part from a locomotive, the substitution of a repaired part and releasing the engine, the defective apparatus being repaired at leisure. For instance, a set of driving wheels needing tire turning are replaced by an extra set in good condition, this operation requiring not more than five hours with adequate drop pit facilities. Air compressors, controllers and contactors can be handled in the same way.

The steam locomotive can not be maintained on this plan, as the boring of cylinders and resetting flues make it necessary to shop the engine, withdrawing it from service for a considerable length of time.

It is quite possible the foregoing statements of personal experience and opinions will not prove as convincing as the records made by an electric equipment maintenance department organized by and largely consisting of men whose earlier experience and training were obtained in the motive-power department of steam railroads. It seems reasonable common sense will conclude there can be no particular mystery or unusual danger in maintaining electric locomotives when the records for the year 1912, after five years service, show a cost of less than 4 cents per mile and an average of 48,271 miles per train detention due to electrical apparatus, with a banner record of 249,423 miles (equivalent to ten times around the world), without a train detention due to the electrical equipment.

Discussion.

C. B. Keiser (Penn. Term'l.)—On the Pennsylvania we have two electrified divisions, the West Jersey & Seashore and the Manhattan, both of which are operated by steam men. The entire organization is under the direction of a master mechanic. Mr. Quereau has referred to an article in the *Electric Railway Journal* of March 15, where it was stated that the total number of detentions to electric locomotives in 1912 was 66 minutes for a mileage of 994,000, so it may be seen that the detentions were very low. In 2½ years we have our first armature to rewind. I do not think it requires any special organization to take care of electrical equipment.

S. A. Bickford (N. Y. C. & H. R.)—You will need a few men who have some knowledge of electrical equipment, but the personnel of the men in an electric shop does not differ from that in a locomotive shop. On our force we have no trained technical men, except a few who are taking student courses. The electrical engineer is more concerned at present about the design than the maintenance of electrical equipment. At present the electric locomotive has not reached the high state of development of steam equipment, due largely to the increased loads placed upon it.

G. W. Wildin (N. Y., N. H. & H.)—We have had two branches electrified for years. These are handled by master mechanics along with steam equipment and there have been no complaints. In our electrified zone, however, up to the first of the month, I did not have full control. We had an electrical superintendent who kept everything he knew under his hat. This division has now been reorganized and I have an assistant mechanical superintendent who has grown up on a steam line, in direct charge. I believe that in electrical operation 99 per cent is mechanical and 1 per cent electrical.

LOCOMOTIVE TESTING PLANT.

An individual paper on the locomotive testing plant and laboratory at the University of Illinois was presented by Prof. E. C. Schmidt of that university. This paper was similar to the one presented at the March meeting of the Western Railway Club and published on page 141 of the April issue of the *Railway Master Mechanic.*

Discussion.

D. R. MacBain (L. S. & M. S.)—I think that the railroads will more than ever avail themselves in the future of such plants and I move a vote of thanks to Professor Schmidt.

This motion was carried.

A. W. Gibbs (Penn.)—Could Mr. Schmidt give us any experience as to the success of the cinder collector.

Professor Schmidt—It has been successful so far, but we have not run the plant to its capacity and are not in a position to judge. The device is almost identical with one used on the Lackawanna at Scranton.

MAIN AND SIDE RODS.

The report on the above subject was submitted two years ago, was discussed at the last meeting, and was held over for a year for consideration, to be brought up again at this meeting for possible adoption as a standard.

During the past year the committee has received a number of letters, some containing suggestions, as follows:

First: As it will be but a short time before heat-treated and alloy steels are introduced, maximum allowable stresses for such materials should be recommended.

Second: That allowable pressure per square inch for pin bearings be specified, and a ratio of length to diameter of pins be established, especially for high-speed engines.

Third: Offset rods for locomotives with three pairs of drivers sometimes have all of the offset in rod between two drivers, and none between the third and middle driver. It is then not positively necessary that the total offset be taken as leverage for bending.

These suggestions have been considered, but were not deemed of a nature to require changing or adding to the previous report. Taking them in their order, we would report as follows:

First: We are not yet justified in giving a limit of stress for heat-treated or alloy steels, as too little is known concerning such material in actual locomotive service.

Second: The design of pins is necessarily handicapped by the available space, therefore the designer is restricted, and must obtain best results regardless of preferred bearing area and desired ratio of length to diameter of pin. Furthermore, the design of pins is not a part of the problem submitted to us.

Third: A general rule for type of offset rods described can not be formulated without danger of having it misapplied. The rule as given may err slightly on the safe side, but can not be misapplied. It is therefore preferable to make no change.

In addition to the above, we would call attention to a correction that should be made in the original report:

In Volume XLIV, 1911, page 137, at bottom, a change should be made, as follows:

The minimum area at points indicated by letter "b."

For main rods and main pin bearing of side rods, $A = \frac{Px}{30000b}$

For side rods, except main pin bearing, $A = \frac{Px}{60000b}$

The report, including the correction just noted, is respectfully submitted for adoption as standard practice.

Committee: W. F. Kiesel, Jr. (Chairman), H. Bartlett, G. Lanza, H. B. Hunt, W. E. Dunham.

Discussion.

J. A. Pilcher (N. & W.)—I move that the report be referred to letter ballot for adoption as recommended practice and the committee be discharged. This motion was carried.

SAFETY APPLIANCES.

President Crawford—The next report is that of the committee on safety appliances. As I am chairman of that committee, I would say that nothing has occurred for the consideration of this committee during the past year.

H. T. Bentley—I move the report be accepted and the committee discharged. This motion was carried.

MAINTENANCE OF LOCOMOTIVE BOILERS.

The committee made the following report relative to maintenance of locomotive boilers. The report on design and construction was presented to the members at the last convention.

The maintenance of locomotive boilers is an important factor, and the greatest difficulties are leaky flues, leaky mud rings, broken stay bolts and cracks in the fire-box sheets. Leaky flues give the greatest annoyance, and your committee has been instructed to investigate the results obtained by electric welding, especially for fire-box work, and we have included in our report results obtained by oxy-acetylene process, which is used extensively.

All large roads have either oxy-acetylene or electric welding outfits at their principal shops, some having both kinds, and either type is installed at principal engine houses.

Some roads install electric welders in such a location that they can be used in the shop as well as the engine house. Both the engine house and shop are wired in such a manner that they can be cut in at any desired place.

The oxy-acetylene can be arranged in the same manner by running pipes from the central plant to any part of the engine house or shop.

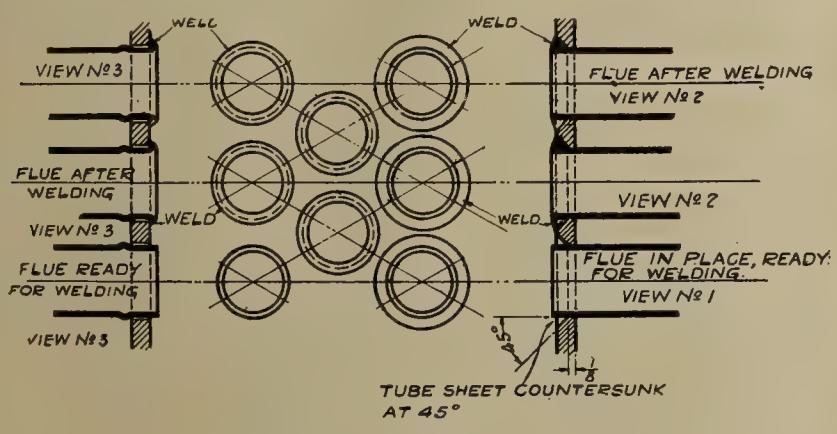
Some roads maintain a complete portable oxy-acetylene cutting and welding outfit, which can be used in both shop and engine house.

Welding both small and large superheater tubes in the back sheet has been done extensively by some roads.

One road has welded in two sets of small flues with electric process; flues were beaded over in the regular manner and set with copper ferrules, but have not been in service a sufficient length of time to give any complete data, mileage at last report being 11,565 and 2,788.

Another road has had experience in welding small flues with electric process, which were applied with copper ferrules, rolled, prossered and beaded and afterwards welded; 100 tubes were applied without copper ferrules and have made 25,712 miles and were in good condition at last shopping in October, 1912. They have had no experience with welding in the large superheater tubes.

Another road, using electric process, welded beads of small and large superheater tubes, after they had been set in regular manner, but they gave trouble on account of leakage. It proved successful where the material of the flue was in good condition. An experiment was made



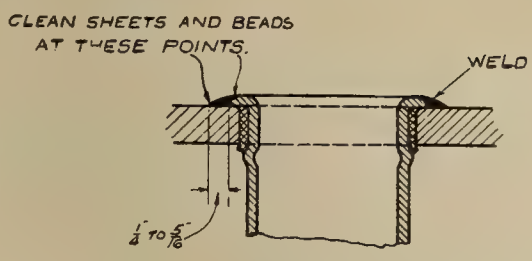
METHODS OF WELDING FLUES.
Fig. 1.

by the same road on three engines, omitting copper ferrules, and it did not prove successful on account of not countersinking the sheet to allow for welding bead on flue.

A road using the oxy-acetylene process has welded in a number of small tubes and omitted copper ferrules; they could not make satisfactory welds with the ferrules. Not only are the welds better by omitting them, but the cost of the ferrules is saved. The tube sheet was prepared as shown in Fig. 1.

The tubes were allowed to project far enough beyond the sheet so that when finished the beads are the same size as when beaded in the regular manner. They experimented with flues which were allowed to extend through the sheet $\frac{3}{16}$ inch and were prossered and then welded, after which a beading tool was used to smooth up the bead. This set of flues has been in service only a short time, and so far has been satisfactory.

A road using oxy-acetylene process for welding in flues believes that the copper furrules are not necessary. The flue sheet is prepared as follows: The old flue having been removed, the first operation is to draw the centers of the back and front flue sheets toward each other. The center of the back sheet is drawn forward about 1¾ inches, and the front sheet is drawn backward about 1½ inches. This is accomplished by applying eleven stay rods distributed in a circle about 2½ feet in diameter, one of the rods being located in the center. While these rods are under tension the back flue sheet is annealed around



WELDING OF FLUES. ELECTRIC PROCESS

FLUE SHEETS PREPARED BEFORE WELDING FLUES. THE FLUE SHEET MUST BE CLEANED FROM ALL SCALE AS WELL AS THE BEAD OF THE FLUE AND THE WELD IS MADE FROM THE EDGE OF THE BEAD TO THE SHEET. SEE SKETCH ABOVE.

Fig. 2.

the edges by an oil torch. Rods are then removed and there is a permanent dish in the back sheet of about 1¼ inches, and in the front sheet 1⅛ inches. The holes are then countersunk on the fire side to a depth of ¼ inch with a countersinking tool, the cutting faces of which are at an angle of 90 degrees. Flues are then set in place, projecting ⅛ inch beyond flue sheet, then rolled and ready to be welded.

One road had considerable difficulty with the large superheater tubes in the back flue sheet, and one engine which had a flue mileage of 75,000 miles was brought to the shop and large flues welded with electricity. Nothing was done to flues or beads except to clean them before welding. These flues were originally applied with copper ferrules in accordance with Plate Z-2, shown in the 1912 report. Metal was built around the bead as shown in Fig. 2, and the weld was made from the edge of the bead to the sheet. The reason ferrules and flues were prossered and rolled was that the welding was more in the nature of an experiment, and proved so successful that this method was continued. The engine was placed in service and has made 14,000 miles without giving any flue trouble, and present indications are that the welding is very satisfactory, and owing to the success of this method new installations are made in accordance with sketch F. In addition to this, on one division they have 96 superheater engines having a total of 3,024 large superheater tubes, all welded, and having a total of 24,655 small tubes, of which 3,557 are welded. The reason that all tubes were not welded was, when the welding was commenced, it was only extended to the large superheater tubes and the small ones which are located adjacent to the large tubes. The total

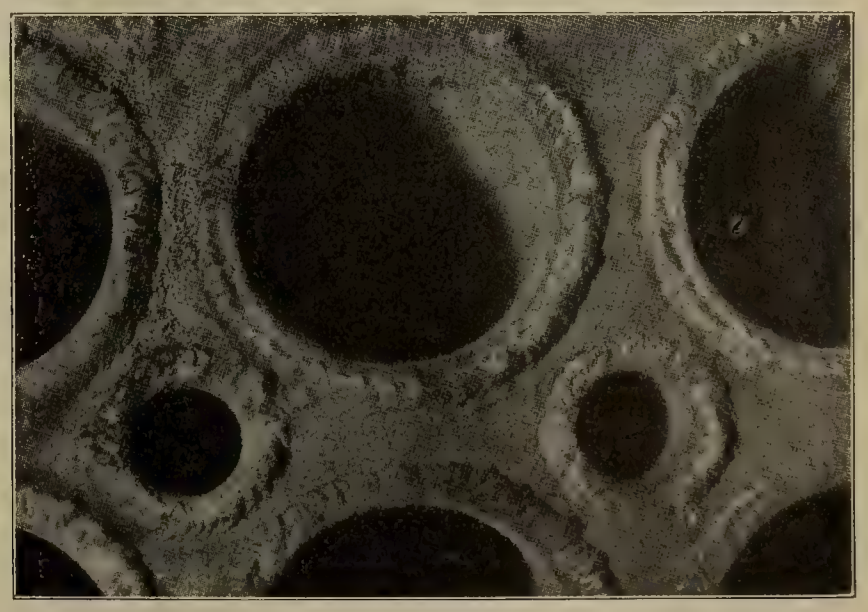


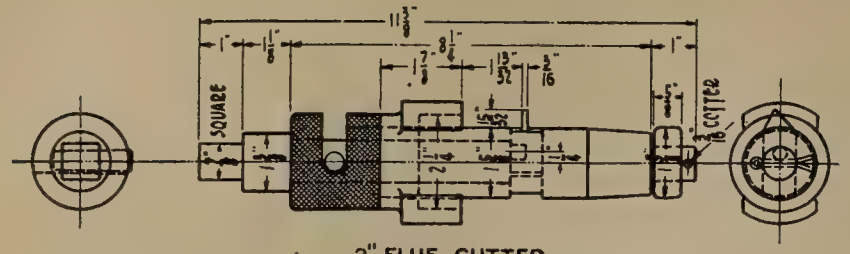
Fig. 3.

flue mileage of these 96 engines is 1,117,437 miles, and up to date there has not been one case of welded flues leaking. This practice has been extended over the entire road, and about 200 engines are running with the flues welded, and other engines are welded as rapidly as possible. Experiments were made with the oxy-acetylene and electric process, the electric process proving more satisfactory for welding in tubes. Fig. 3 shows enlarged view of these flues. This engine was taken out of service to obtain this photograph.

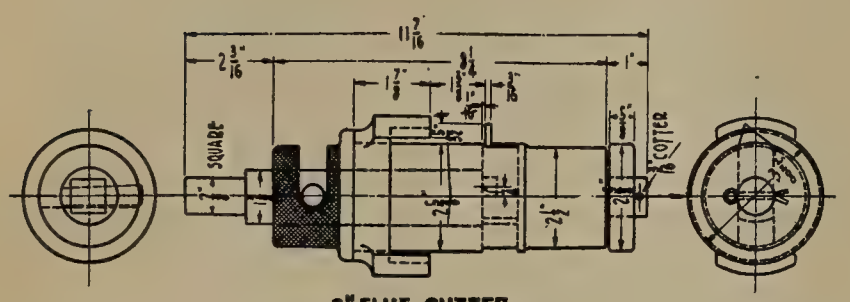
When welding in flues, the method is to start at the bottom and weld through the center up to the top of the flue sheet and then weld from the center out to either side. This was the method used previous to welding.

One road welded 11 tubes as stay tubes, distributed evenly over surface of flue sheet. The flues are then welded, the operator starting at the center and welding concentrically outward until all have been welded. It is unnecessary to adopt a special method of welding tubes other than what was followed previously for prossering tubes.

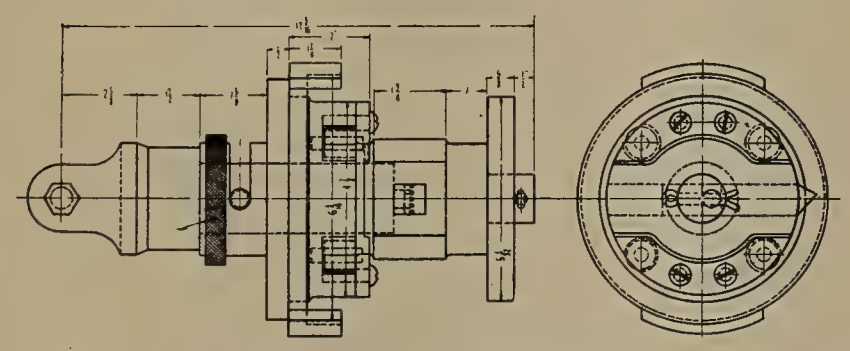
Two roads using oxy-acetylene process chip off the high spots and use an ordinary beading tool; others do not go over flues in any manner.



2" FLUE CUTTER
GENERAL ARRANGEMENT



3" FLUE CUTTER
GENERAL ARRANGEMENT



6⅝" SUPERHEATER FLUE CUTTER
GENERAL ARRANGEMENT

Fig. 4.

Roads using electricity find it unnecessary to smooth off the welds.

One road reports that they use iron safe-ends, as they experienced considerable trouble on account of steel safe-ends breaking in the welds on iron flues. The majority of other roads who weld in flues use steel safe-ends and no difficulty is experienced.

No difficulty has been experienced by any of the roads on account of flue sheets being too thick or too thin when welding-in flues.

It has been found that it takes about three hours longer to cut out a set of flues which have been welded. In removing these flues no special difficulty has been encountered.

Fig. 4 show tools used in removing flues. These tools have proven very successful in cutting out flues.

When flues are welded-in, the maintenance is less than when tubes are prossered. It is unnecessary to give any special attention to welded tubes when boilers are washed. This reduces the maintenance cost.

From the reports received from different roads they indicate that considerable difficulty was experienced in welding flues with the oxy-acetylene process, while the roads using the electric process report very satisfactory results, especially by one of the roads that tried out both methods and found that the electric process gave such good results that it has adopted this for standard practice, and has at least 200 engines now running with flues welded in. The flues have seen considerable service, and when engines were brought into shop for intermediate repairs it was not necessary to remove the flues, which had been their practice theretofore. Therefore, your committee recommends electric process for welding flues. The committee also recommends that flues be set with coppers, prossered and beaded in regular manner before welding, until it is clearly demonstrated that other methods are equally as good or better.

Figures were obtained relative to the cost of welding-in flues with oxy-acetylene and electric process, also the regular method, which consists of applying coppers and prossering tubes. One road using oxy-acetylene for welding the flues, reports that it costs $178.65 to weld in a set of 249 tubes, which includes gas and all work preparing flue sheets and safe-ending flues. This averages 71 cents per flue, and the regular method, which consists of safe-ending and applying coppers and other work for the same number of flues, is $55.05, averaging 22 cents per flue.

A road using oxy-acetylene for setting the flues, as shown by Fig. 1, reports that a set of welded flues, containing 335 flues, amounts to $18 for labor, $15 for gas, making a total of $33, or .098 per tube. No coppers are used by this road when welding in tubes. The regular method for the same number of flues costs $25.25, or .075 per flue. These figures include only such work as necessary to set flues.

A road using the electric process of welding flues reports that the cost of labor complete to weld beads on 404 2-inch flues is $14.98, or .037 per flue. The cost to weld in 328 new flues as shown on these sketches is $10.08, or .03 per flue. The cost of labor complete to cut out 404 2-inch flues, weld safe-ends and apply old method with coppers, prosser and ready to test boiler, is $64.25, or .15 per flue. A fair comparison can not be made on account of no cost being given for preparing flue sheet and safe-ending flues before welding.

A road using electric process for welding the flues, as shown in Fig. 2, reports the cost of welding 34 4½-inch tubes and 32 2-inch tubes—labor, $4.12; current, $2; material, $1.25. Total, $7.37. One 4½-inch tube is equivalent to two 2-inch tubes; therefore, this amounts to 100 2-inch tubes costing .073 per flue. The standard method of setting the flues by the same road, which consists of safe-ending, applying coppers and prossering, is .089 per flue, and adding the cost of welding (.073) makes a total of .162, which is the cost of welding one 2-inch tube, as shown by Fig. 2.

We are reporting below the cost of setting flues by different roads. This cost is old method:

A. .06 a flue ready for testing, new flues.
B. .06 a flue ready for testing, new flues.
B. .14 removing, cleaning, safe-ending and resetting.
C. .13 removing, cleaning, safe-ending and resetting.
D. .067 installing copper ferrules, setting flues, rolling front ends, setting and beading fire-box end of tube.
E. .044 per flue for setting tubes only, includes copper ferrules.
F. .04 per flue for setting tubes only, includes copper ferrules.
G. .036 per flue for setting tubes only, includes copper ferrules.

From the above figures, it appears that the cost of welding flues in accordance with electric process is cheaper than the oxy-acetylene process. It also gives better service. The cost per flue is, of course, increased if weld is made after flues are set in regular manner. It must be remembered that the maintenance cost is almost entirely eliminated, also that engine failures are avoided and engines can be kept in service a greater length of time. Present indications are that flues can be run the three-year limit without removal.

None of the roads are welding-in tubes in the front tube sheet, as it does not seem to be desirable to change the method now used.

Vertical Cracks in Side Sheets.

Vertical cracks in the side sheets are welded with both oxy-acetylene and electric process. Seven roads get good results with electric process when cracks do not exceed 12 inches in length.

One road advised very poor success with welding vertical cracks with the oxy-acetylene.

One road reports good results with electricity, with the following practice: The cracks are cut V-shaped ½ inch at the top and $\frac{3}{16}$ inch at the bottom, as per sketch I; remove the stay bolts and weld cracks and staybolt holes, redrill the holes and apply stay bolts; they have obtained better results with this method than welding over the bolts. Poor results were obtained by using the oxy-acetylene by this same road.

Another road using oxy-acetylene reports as having welded vertical cracks in side sheet, but with very poor success. Their experience has been that the vertical welds fail more rapidly than the horizontal welds, and when the fire box has a long, vertical crack the entire side sheet is cut out and a new sheet is inserted by making a horizontal weld the full length of the fire box. Very small cracks can be successfully welded with electric welder.

The method used by all railroads is to V out the sheet ⅜ inch to ½ inch at the top and ⅛ inch to $\frac{3}{16}$ inch at the bottom.

Cracks in Back Flue Sheet at Top.

Cracks as long as 38 inches have been welded successfully with both types of welder. Sheet is cut out a few inches beyond end of crack to avoid new crack from starting, and is dressed out V shape the same as cracks in fire box. Some roads preheat the sheets before welding.

Cracks in Crown Sheet.

Cracks are successfully welded in crown sheet with both processes. One road, using oxy-acetylene process for welding cracks at the flue sheet, cut off the forward part of the crown sheet and welded a strip the full width of the crown sheet, about 6 or 8 inches deep. This was done to avoid any new cracks developing at this location. It was found that this gives more serviceable results.

Cracks in Door Sheet.

Cracks have been successfully welded with both types, but the oxy-acetylene is preferred, as it gives more satisfactory results. One road pre-heated sheets before welding.

In preparing fire-box sheets for electric welding, the crack is V'd out to an angle of about 65° and the metal is filed bright.

For oxy-acetylene it is V'd out to an angle of about 90° and no filing is required; the metal is built up from the fire side of the sheet.

Considerable difficulty has been experienced by roads, using both oxy-acetylene and electric, on account of welded cracks opening up after service from three to eight months. The percentage in some cases, which are few, runs as high as 15 per cent. About 5 per cent is the average.

One road using oxy-acetylene welded-in half side sheets on a few switch engines in 1910. These welds have not given any trouble since the engines were turned out of the shop.

One road reports that in a period of five months, October 1, 1912, to

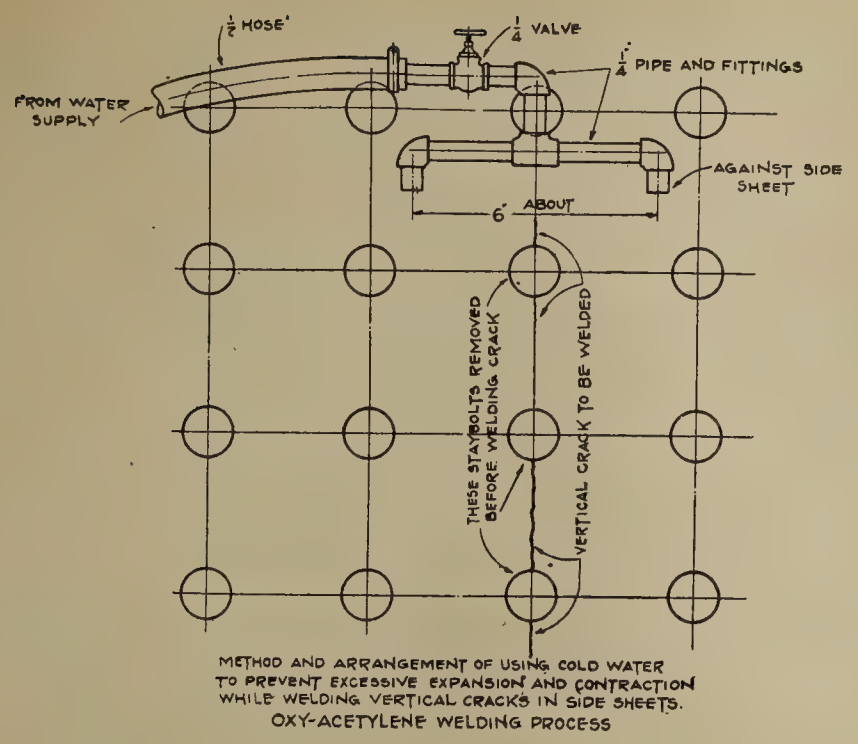

½ HOSE
¼ VALVE
¼ PIPE AND FITTINGS
FROM WATER SUPPLY
AGAINST SIDE SHEET
6" ABOUT
THESE STAYBOLTS REMOVED BEFORE WELDING CRACK
VERTICAL CRACK TO BE WELDED
METHOD AND ARRANGEMENT OF USING COLD WATER TO PREVENT EXCESSIVE EXPANSION AND CONTRACTION WHILE WELDING VERTICAL CRACKS IN SIDE SHEETS.
OXY-ACETYLENE WELDING PROCESS

Fig. 5.

March 1, 1913, 3.5 per cent of electric fire-box welds failed before the end of the period, an average life of 58 days. In the same period 1.8 per cent of oxy-acetylene fire-box welds failed, an average life of 53 days.

It is considered that very good service is obtained in welding cracks and sheets in fire boxes by both processes. Most of the difficulty was experienced in the earlier days when this method was new, and after the operators became more familiar with this line of work considerable improvement was noticed in the service of welded cracks, etc. The same can be said of new cracks developing adjacent to welded cracks. This trouble is very rare and it is not serious.

Some roads using oxy-acetylene use water on each side of the weld, as shown in Fig. 5, and other preheat the sheets to take care of the expansion and contraction. Roads using electric welders do not have any special method of taking care of the expansion and contraction.

When welding cracks in the fire-box sheets which embrace three or four stay bolts, the best practice is to remove stay bolts, whether broken or not, and weld sheets solid and drill new holes for stay bolts.

When renewing broken stay bolts in the vicinity of cracks in the fire-box sheets, which have been welded, occasionally a weld will open up, due to vibration of hammers used in chipping, caulking or driving up stay bolts. These cases are rare, however, and the second weld made usually holds goods. To prevent this, some roads endeavor to keep the sheets hot while driving bolts.

Welding Bridges in Front and Back Flue Sheet.

Bridges have been welded in both front and back tube sheets with both processes and give fairly good results, although some roads have had difficulties with oxy-acetylene. Sheets in some cases must be preheated before and at the time of welding to take care of expansion and contraction, also to prevent cracking of adjacent bridges. Flue holes are rolled while the sheet is hot.

Full fire-box sheets are welded successfully with both types of welders, and in some cases experiments have been made with welding the flange of the flue sheet and the door sheet to the side sheet, omitting the rivets.

One road had a switch engine built at a locomotive works, and all the fire-box seams were welded with the oxy-acetylene process. There are no rivets in this fire box except the ones that fasten the box to the mud ring. Engine went into service August, 1912, and has given no trouble with the seams leaking or otherwise. Three-quarter door sheets have been welded in by one road and the rivets have been omitted where the sheet is welded to the side sheet. Another road reports having welded door sheets from the fire-box door down to the mud

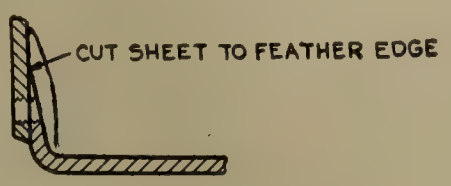


Fig. 6.

ring. The rivets were cut out and plugs screwed into rivet holes which were cut off flush with the sheet and welded over as shown in Fig. 6. Fig. 7 shows method of applying patches at door hole and back head.

Another road, using electric process, reports that some patches in fire-box side sheet fail in from one to three months. Patches in the crown sheet give no trouble. Door-hole collar gives good service, and any patches in fire box, applied round or oval, will give better service than square ones which are welded on three or four sides.

Another road, using oxy-acetylene, reports welding patches in fire-box sheet, using a box patch. Results were very satisfactory, the vertical weld separating in nearly all cases; therefore they have discontinued welding-in patches and now supply the side sheets full length, confining the weld to the horizontal seams. The size of the patches they experimented with varied from 12 by 12 inches to 36 by 36 inches.

Another road, to overcome the difficulty they were having with the vertical welding, applied patches cut diagonally. Since adopting this practice they have been very successful with the oxy-acetylene.

Plugs and sunflowers have been successfully welded with both processes. The plugs were applied in the usual manner and then welded around the edge, the same as welding flues.

There have been cases where stay-bolt holes and washout-plug holes have become enlarged, and holes, in some cases, especially the stay-bolt holes, have been welded up entirely and redrilled and retapped for new bolts with satisfactory results. On washout-plug holes patches have been applied 4 or 5 inches in diameter and welded and new holes drilled for the plugs; washout-plug holes have been reinforced around the hole for a distance of ½ inch or more. This work has proved very successful with both types of welders.

Welding of Mud Rings.

Welding of cracks in mud rings have been successfully done with both types of welder. One road, using electricity, reports that only one out of six failed.

Mud rings have been welded on the fire-box sheets at the corners in addition to riveting. This is done to eliminate mud-ring leakage and has proved very successful with both types of welder. No road has reported welding sheets to mud rings, omitting the rivets.

Building-up of metal at the mud rings is done by roads with both types of welder and has proved very successful.

One of the large roads, having experience with both oxy-acetylene and electric welders, reports that the oxy-acetylene heats the plates more than the electric, causing the plates to contract more when cooling down. Allowance must be made to take care of the contraction according to the particular work being done. Different classes of work require different allowances for contraction, also much depends on the operator.

With electric welding the contraction is much less, due to the fact that there is no flame, except when the feeding metal is in contact with the plates welded. The heat is confined to the point of contact,

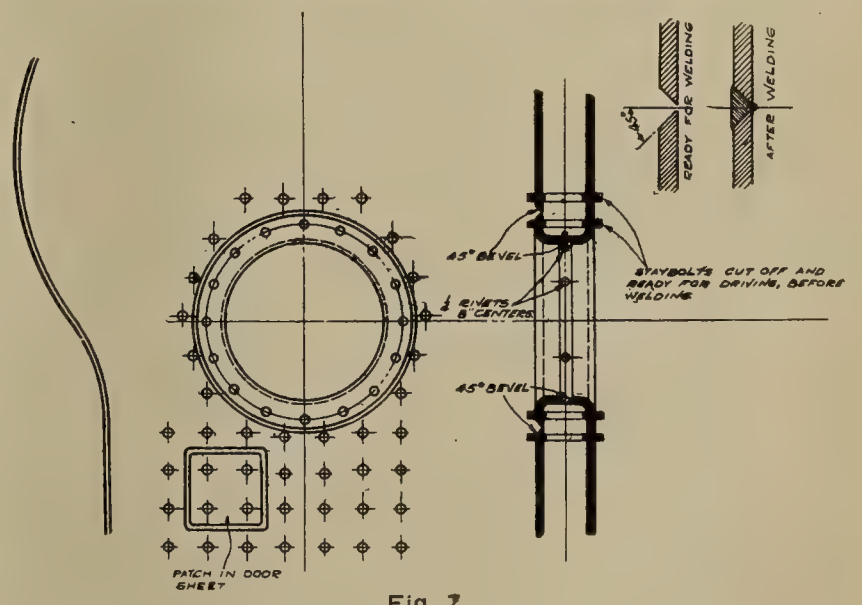


Fig. 7.

thereby causing little expansion.

One large road recommends electric welders for general boiler work, for the following reasons:

First: Because the possibility of danger is eliminated.

Second: Because it is at least 50 per cent cheaper.

Third: Because the electric apparatus is easily handled and more convenient.

Fourth: Because the work is more efficient.

Five other roads recommend electric welding for general boiler work.

Another large road, which uses both methods of welding, reports that the oxy-acetylene method is superior to electric for the following work:

Welding-in whole or part side sheets. Welding patches to all sheets. Welding cracks 12 inches or over.

It considers that the electric method is superior for the following work: Reinforcing corroded sheets. Filling in on all caulking edges of sheets. Welding bridges in flue sheets. Filling in around washout holes and all cracks in fire-box sheets under 12 inches.

The committee feels that there is a field in which each of the two welders, that is, electric and oxy-acetylene, excels the other. For welding seams, cutting out and removing old sheets, the oxy-acetylene excels. For welding flues, short cracks and welding metal, where expansion must be taken care of, the electric welder excels.

At engine houses the committee would recommend that electric welders be installed, and at shops both electric welder and oxy-acetylene

process be used, as oxy-acetylene process can be kept busy cutting out and applying new sheets.

Washing of Boilers with Hot Water.

Of the roads reporting, it is the consensus of opinion that boilers should be washed with hot water. It avoids sudden change in temperature, with which process the stay bolts and fire-box sheets and boiler can be washed clean in a shorter time. Most railroads install hot-water plants when building new roundhouses.

One road reports having a special boiler-washing plant which consists of two washout pits about 150 feet long. The engines are placed on the pits and connected up to blow-off cock with a high-pressure flexible hose. This is connected to a pipe line which conveys the steam and water into a filtering plant, which consists of three large tanks with a total capacity of about 30,000 gallons. It is equipped with two motor-driven Buffalo turbine pumps which pump the water out through another line for washing and filling of locomotive boilers. All water used in washing runs back into the tanks by gravity system and passes through the filtering pits of hard coke, etc., on its way to the tanks. They advise that this plant is very satisfactory, as there is no loss of steam or water from boilers or tenders.

Another road has installed its own system, which provides for the blowing off of all water and steam from the boilers to the tank. The foul water from this tank flows off to the sewer. The steam separates and passes to a concrete cistern which is filled with fresh water admitted by a thermostatic control. The steam enters this cistern through two pipes at the top, the pipes extend down close to the bottom of the cistern. At the end of the pipes are 4-inch noiseless heaters. The steam heats the water in the cistern to 140 degrees, and when the temperature rises above 140 degrees more water is admitted automatically, the supply shutting off when the temperature reaches 140 degrees. The water is then pumped from this cistern to the roundhouse and is used in washing and filling boilers. The exhaust steam from the pumps is piped to the cistern for heating purposes.

There are a number of patented systems now on the market with which the members are familiar.

The steam which is blown from the boilers is used in heating water to wash boilers and for heating the water for filling boilers. The water for filling the boilers varies from 125 to 215 degrees. The water that is blown off is filtered in most cases and used for washing boilers. With these systems boilers can be washed quickly, as it is unnecessary to cool the boiler down. In case the boiler cools on account of engine awaiting repairs, it should be washed with cold water.

The temperature of hot water for washing purposes varies from 130 to 180 degrees.

One road advises that it takes two hours and thirty minutes to wash a boiler with hot water, from the time the locomotive is brought in and placed on the pit, completely washed, replace the plugs and get the engine under steam ready for service.

Some roads have gone so far as to install the hot-water system in old engine houses, where a large number of engines are handled. Hot water is used for filling boilers after washing with hot water, and boilers are filled through the blow-off cock, boiler check, or valve on the dome or top of the boiler. Most washout plants now installed have a connection on the top so that the boiler may be filled through the valve, with either hot or cold water, as the case may be.

One road not having an up-to-date washout system has installed a by-pass valve in the steam-pipe leading to the cold-water line at the hydrant plug. Steam is turned on, heating the water to about 120 degrees.

Washing of Boilers with Cold Water.

When washing with cold water, care should be taken that the boiler is properly cooled before cold water is turned into same. The general practice is to remove two washout plugs in the backhead above crown-sheet, connect the cold-water hose to the feed pipe, which allows the cold water to pass through the injectors and boiler check and mix with the hot water in the boiler, thereby allowing the water to escape through the washout holes. By this method the boilers may be fairly well cooled down, and after this has been accomplished all washout plugs are removed, which will allow the boiler to drain itself. With this method it consumes more time than washing out the boilers with hot water. It requires from forty to sixty minutes to cool the boiler down.

One road using cold water reports that it takes six hours and twenty minutes to cool a boiler down, wash it, fill it, and fire it up again ready for service.

In filling boilers with cold water, the general practice is to fill through the boiler checks.

The up-to-date hot-water systems referred to above also have a cold-water line running parallel with the hot-water line, for use in case it is ever desired to wash a boiler with cold water.

The washing of a boiler is a local proposition and depends on the water conditions which have to be met; therefore, no hard, fast rules can be recommended by this committee to govern the washing of boilers.

The number of times a boiler is washed depends upon water conditions; after the boiler is washed the flues are examined carefully, and any flues not welded, which show signs of leaking, are gone over with a prosser. Fig. 8 shows a straight prosser used for small and large tubes.

Some roads prosser full sets of flues every thirty days, using a long-stroke air hammer. If leaking between this time they are expanded by a sectional prosser expander, driven to place by a hand hammer, or beaded with the air hammer and beading tool. The form of the beading tool must be kept to original dimensions by frequent gauging.

One road takes into consideration the mileage, combined with time element; for example, reset every four weeks on freight engines that have made 8,000 miles or over, and every six weeks on passenger engines making 6,000 or 8,000 miles.

If careful attention is given to condition of the fire and the use of feed water on the road, by hostlers and fire cleaners in cleaning fires and not putting water in the boilers when the fire is out or partly out, and the engine is looked over while standing on the ash-pit, unless beads are getting weak, engines will go from washout to washout without giving any flue trouble.

Complete and partial sets of flues are sometimes applied between shoppings of engines. The mileage varies from 40,000 to 60,000, and one road reports having obtained 75,000 miles.

The flue mileage equals the engine mileage on some roads, and on others the mileage doubles that of the engine mileage. One road obtained 50,000 to 75,000 miles on bottom flues, and the top flues ran between shoppings.

Another road's practice is to remove bottom flues at first shopping of engine, and at next shopping remove the entire set. This gives them generally from twelve to sixteen months for bottom flues and twenty-four to thirty-two months for top flues. Their water conditions are very good. The majority of roads find it necessary to renew as many as half of the flues on this account. No rules can be recommended for fixed flue mileage. This must be governed by local conditions.

If flues are welded in, the present indications are that they can be run for three years, which is the limit prescribed by the federal rules.

Water Conditions.

A few roads have what would be called good water conditions. Practically all roads are using treated water in some form. Soda ash is used considerably. One road uses a continuous method of water treatment, namely, the Kennicott. Chemicals used are lime and soda ash. In addition to this water treatment they use a boiler compound to some extent, chemicals being introduced to the tender by engine men and roundhouse employes.

Another road is getting good results from twelve water-softening plants of the Otto and Kennicott design.

A few roads are using a boiler compound which is made in stick form about 18 inches long and is applied after the boilers have been washed, through the washout holes and laid on the crown sheet, and a few sticks are laid on top of the flues at the rear end. This compound

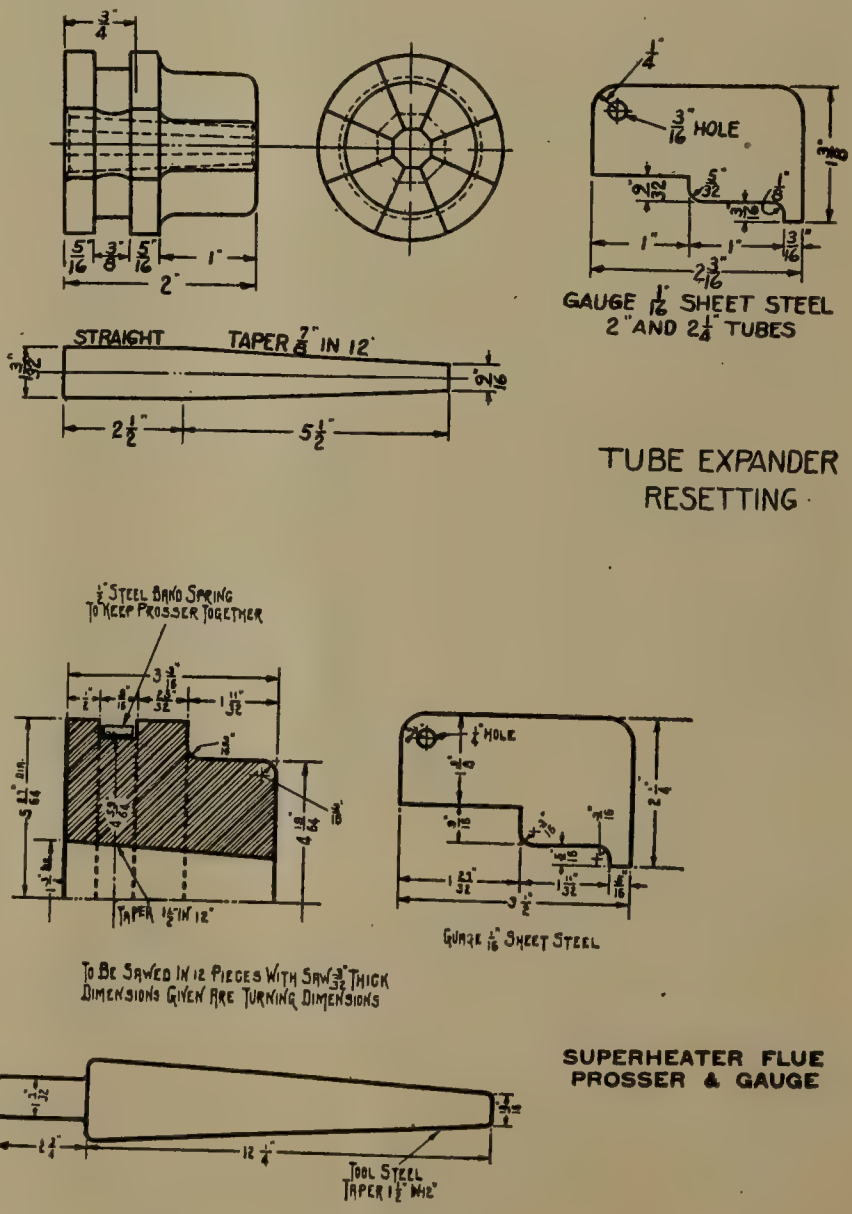

STRAIGHT
TAPER 7/8" IN 12"
GAUGE 1/16 SHEET STEEL
2" AND 2 1/4" TUBES
TUBE EXPANDER RESETTING
1/4" STEEL BAND SPRING TO KEEP PROSSER TOGETHER
TAPER 1/2" IN 12"
TO BE SAWED IN 12 PIECES WITH SAW 3/32" THICK
DIMENSIONS GIVEN ARE TURNING DIMENSIONS
GUAGE 1/16" SHEET STEEL
SUPERHEATER FLUE PROSSER & GAUGE
TOOL STEEL TAPER 1/2" PER FT.

Fig. 8.

has increased the mileage between washouts over 150 per cent on a road which has very bad water conditions, and it has been in use almost a year. In addition to increasing the mileage between washouts, it has increased the life of boiler flues. A boiler compound which will lessen washouts and give increased flue mileage and is not injurious to the sheets is an important item when it comes to maintenance of a locomotive boiler.

The use of the blow-off cock by engineers en route is prohibited on some roads. The blow-off cock is only used at the terminals; other roads allow the engineers to use blow-off cocks while en route in case the boiler is foaming. Some roads have special men at their principal terminals, employed for blowing out one or two gauges of water from the boilers just prior to taking water when leaving the engine house.

It is important to keep the arch tubes free from scale, and when washing boilers it is the general practice to use a Cyclone cleaner through each tube until all scale is removed; and the arch tubes are then inspected by the foreman in charge of washing boilers, to know that tubes are clean.

The Lagonda arch-flue cleaner is used by a good many roads. The cleaner is started into arch tubes at the boiler head. It is driven by air, and a small stream of water is entered through a separate pipe for the purpose of washing down the scale. The cleaner is run through gradually, making sure to remove all of the scale from the arch tubes. A clamp is fastened to the hose to regulate the depth to which the arch tube cleaner can go. This depth is such that the cutters on the cleaner will not pass beyond the lower end of the arch tube.

In order to get the most efficiency out of a boiler, it is necessary to keep the flues from stopping up. It is found that clinkers accumulate just back of the superheater units. If these are neglected they will grow to such proportions that they will entirely obstruct the flues.

Some roads blow out flues at the end of each trip, especially on important power. Others blow them out at each washout. The blowing is done with air pressure from 100 to 200 pounds, using a ¼-inch pipe for blowing out the superheater flues, and ⅜ to ½-inch pipe for other flues. Pipe is generally as long as the flues, so as to pass clear to the end. When small tubes cannot be cleaned by air they are bored out by an auger as shown on sketch P-1. One road, using oil as fuel, reports that flues do not stop up with this kind of fuel.

The matter was canvassed with different roads in regard to small superheater tubes clogging up on the inside and whether they have any special method of cleaning out the units. All roads, except one, who have a large number of superheaters in service, report no difficulty. They found some of the units almost closed up at the return bends, which was caused by the use of too much soda ash and by foaming. Soda ash was discontinued for a while and the trouble was eliminated. However, they have gone back to the use of soda ash, using smaller quantities.

Flexible Stay Bolts.

The committee reported at the convention last year that one of the members applied a full installation of flexible stay bolts to a locomotive fire box in February, 1907, with the exception of four bolts under the auxiliary dome, four under the steam turret and eight bolts which go on top of same at back head. February, 1908, engine received general repairs and fire box was in good condition. All caps were removed from flexible stay bolts and they were found to be in good condition. April, 1909, it was found necessary to patch the top of the back tube sheet on account of sheet cracking from the hole around the flange; this was done in the engine house. October, 1909, engine was given general repairs, and by this time the top of back tube sheet had given out in two more places, but as the sheet was in good condition otherwise, it was patched. Three mud-ring corners also required small patches applied. After rattling scale from fire-box sheets with large hammer, it was found that forty (40) of the flexible sleeves had cracked outside of the sheet, and on being taken out they were found to be crystallized, but no broken bolts were found. In 1911, engine was again in the shop for general repairs and had all caps removed from flexible stay bolts and bolts found to be in good condition. A patch was applied to top flange of flue sheet, half side-sheet seam in fire box was in good condition.

We have further report to make on this engine. Engine was given general repairs July, 1912, and at this time it was necessary to apply new back tube sheet; caps were removed from all flexible stay bolts and none found broken. Side-sheet seam has never given any trouble and engine has lost no time in roundhouse due to broken stay bolts since the box was applied. Mileage up to May 6, 1913, is 398,997 miles.

The committee recommended last year that the members give full installations further consideration and it was suggested that some of the members carry on a further investigation. Five roads report that they are applying complete installation of flexible stay bolts, and three others are experimenting with complete installation.

Of the twenty-four roads reporting, flexible stay bolts are used by all except two. Roads not applying full installation are applying stay bolts in the breakage zone, which consists of 30 to 35 per cent of the total number of stay bolts. Results obtained from flexible stay bolts have been very satisfactory up to date.

Reports as made by the committee last year in regard to applying flexible stay bolts with a certain amount of slack; Plate N, in last year's report, shows the amount of slack and the location followed out by one of the members. Four roads are now experimenting with an installation of this kind and it will be impossible to make a report on the results obtained at this convention on account of not being in service a sufficient length of time; except that one member has reported four broken flexible stay bolts near center of throat sheet.

Nine roads are applying flexible stay bolts with slack in some form. Bolt is screwed in until head is seated in sleeve and then backed off one-quarter turn before driving. Other roads turn them back one-half turn. One road reports that they back off the first and last rows on each side sheet one-half turn, the second and the next to the last rows on each side sheet backed off one-quarter turn. All others are screwed up tight.

The application of stay bolts with some form of slack is believed to be desirable, as it relieves the fire box of excessive internal stresses which would be brought into play if the bolts are turned up tight.

Brick Arches.

To get the most efficiency out of a brick arch it must be maintained properly and not often disturbed. The general practice seems to be to remove the center row of bricks when it is found necessary to bore or work on flues. Only enough brick should be taken out to enable the operator to get at the tubes. They must be removed as carefully as possible to avoid breakage. Some roads have a special brick-arch man, day and night, at the large terminals to make repairs to arches and to see that they are kept in good condition. Brick arch should be blown off with air by a pipe put in through the fire-box door with a tee on the end which will blow the dirt, or a portion of it, to the corners, where there is an opening which allows it to fall out on the grates.

Committee: D. R. MacBain (Chairman), C. E. Chambers, T. W. Demarest, R. E. Smith, F. H. Clark, J. Snowden Bell, E. W. Pratt.

Discussion.

H. T. Bentley (C. & N.-W.)—The committee says that cracks in the crown sheet can be successfully welded by both processes. We welded a crack in the crown sheet some time ago with an electric welder, and upon testing a piece of the sheet found that there was practically no strength left in the crown sheet. We used another welder with the same results, but the third one was O. K. We have welded a large number of sheets with oxy-acetylene, and I agree with the committee that both methods have their uses. I would like to ask if any of the members are having trouble with pitted tubes. Of late we are having a great deal of trouble with them.

C. L. McIlvaine (Penn.)—About three years ago we made a great number of experiments with oxy-acetylene welding, and it proved a complete failure. It was slow work owing to the great heat in the fire box making it impossible for a man to work continuously. About a year ago we started electric welding and it proved a great success. Microphotographs were made of the welds and they showed good results. Electric welding, if not properly made, however, will show lots of holes, and the work should be hammered and cleaned. The first locomotive which we welded has been running about 15 months and shows no leakage. Five more engines have run 8 to 9 months with no leakage except one which leaks slightly, due to a pinhole. We are now running about 44 engines with welded flues, 11 saturated and 33 superheaters. We have had as good results with welding large flues as with small flues.

F. F. Gaines—I would like to ask Mr. Bentley if he used steel flues.

H. T. Bentley—They are steel tubes.

F. F. Gaines—I think that is the answer. We have always had trouble with steel flues pitting. It is necessary to use the sand blast for cleaning the sheet preparatory to welding, or you will not get a good weld.

H. T. Bentley—We used iron flues for many years, and they also gave us much trouble.

B. P. Flory (N. Y. O. & W.)—I am surprised that some roads have had trouble with the electric welder. We have welded some flues in, and so far have had good results. I believe the electric welder is cheaper and gives better results than the oxy-acetylene.

D. R. MacBain (L. S. & M. S.)—As chairman of this committee I wish to say that the work was largely done by Mr. Mirtz, mechanical engineer. The men on the Lake Shore are satisfied that each system has its own particular advantage.

O. M. Foster (L. S. & M. S.)—Since we have had superheaters the large flues have been three or four times as troublesome as the smaller ones. We started in with the large flues, although we did the small ones at the same time. We welded the first set the 27th of last September, and today we have 250 superheater engines on the Lake Shore with flues welded in. As for leaking, there is perhaps one case out of forty where we find the flues a bit spongy. I don't think the sand blast necessary, as in the hands of a careless operator it may do much damage. We have done very little in the application of new flues. Welding a bead gives more flexibility to the tubes. Anyone undertaking to weld in flues had better start in by welding old flues. With regard to the copper, we left the copper in there.

C. E. Chambers (Cent. of N. J.)—We have had an electric welder about a year and four months, but did not weld any flues until February of this year. So far we have had no trouble. Its work in welding cracks has been very satisfactory.

E. W. Pratt, C. & N.-W.)—The report speaks of a complete installa-

tion of flexible stay bolts, and it seems to me that provision should be made for taking up some of the slack of the front stay bolts. Also, in welding large superheater tubes, it seems that we should be able to get more than three years of life from them, notwithstanding the reading of the law. I believe that if this matter was taken up in the proper way with the inspectors we might arrange to continue these large tubes in service more than three years.

H. T. Bentley (C. & N.-W.)—As a matter of information to Mr. Pratt I would say that the makers have a flexible bolt with a screw arrangement on the top for taking care of the slack he speaks of.

D. J. Redding (P. & L. E.)—There are two distinct types of welders, the single and multiple unit equipment. I would like to know if any of the members have had any trouble with the multiple units?

D. R. MacBain (L. S. & M. S.)—I have been informed that there is only one concern furnishing electrical apparatus now, and that they will furnish any type you desire. The Lake Shore has installed a 4-point machine at a roundhouse, and our experience has been very satisfactory.

STEEL TIRES.

The committee on steel tires held meeting during the year to further revise the report submitted at the last convention. After comparing all the information received from the members and manufacturers during the year, the committee is unable to suggest any change in the specification presented last year, except to add a new sub-clause: (d) The elasticity shall be at least 50 per cent of the tensile strength.

The committee discussed the question of using alloy steels, such as chrome, vanadium, etc., but does not feel in a position to express an opinion.

Last year's report was again presented for consideration, and the committee suggested the advisability of appoining a standing committee on "Steel Tires."

Committee: L. R. Johnson (Chairman), J. R. Onderdonk, R. B. Kendig, R. L. Ettinger, L. H. Turner.

Mr. Taylor moved that the report be referred to letter ballot and the question of a standing committee be referred to the executive committee. The motion was carried.

MINIMUM REQUIREMENTS FOR LOCOMOTIVE HEADLIGHTS.

The committee appointed to report on the minimum requirements for locomotive headlights has held several meetings for the discussion of this subject and have kept in touch with the various tests which have been run on headlights in the past year, but does not feel that it is in position to make other than a progress report at this time.

In 1911 the committee sent out Circular of Inquiry No. 6, which, among other things, requested an opinion as to the functions of locomotive headlights, in which the committee agrees, are as follows:

1. To warn employees and the public of the approach of a train.
2. Marker to designate the head end of a train.
3. To permit the enginemen to observe wayside objects, such as whistle posts, landmarks, etc.

The above requirements can be met by the oil headlight or a light of the same energy as the present oil lamp.

Analysis of the oil headlight and of various tests run in the past year develops the fact that the distribution of the light with the various detail arrangements vary to such an extent that it is impossible to make a simple definition of minimum requirements, i. e., it is impossible to designate the minimum size of reflector and candlepower of the source of light without going into the distribution of the light with the headlight as a whole.

The committee has outlined a series of tests to bring this question to conclusion for the report of the 1914 convention if the association so desires.

As to high powered lights, as for example, the electric headlights. Tests which have been made in the past year, confirm the conclusion that they are a decided source of danger when used on roads with multiple track and automatic signals; this confirms the resolution adopted by the Association at the 1912 convention.

Committee: D. F. Crawford (Chairman), C. H. Rae, A. R. Ayers, F. A. Torrey, R. Quayle.

Discussion.

D. R. MacBain (L. S. & M. S.)—We have only opposed high power headlights, but have offered no remedy as to minimum requirements. The high power headlight is compulsory in many states and many state bodies have waited until this body can make a recommendation and I think we ought to go on record at this time.

E. A. Miller (N. Y. C. & St. L.)—Considerable legislation is impending and the managements are asking us as to what headlights should be required.

F. F. Gaines (Cent. of Ga.)—While I am in sympathy with the preceding speakers, it seems impossible to take action at this meeting, as there are so many details such as size of reflector, kind of reflector, lenses, etc., to be determined.

C. H. Rae (L. & N.)—It is a mistake to force the committee to report at this convention. We have arranged to make a series of tests and we want time to carry them out.

Henry Fowler (Midland Ry. of Eng.)—We have on the front one to four oil lamps of 1½ to 2 c. p. which with lenses give 6 to 10 c. p. These are simply as markers; we never expect to light the road up.

Angus Sinclair—In Europe railways are fenced and walking on their tracks is trespass, while in this country people walk on them. The strong headlight is desired to protect people who are violating the law.

D. F. Crawford—Most of the laws require a headlight which is absolutely dangerous. Some laws require practically a ship's searchlight. A majority of accidents occur in daytime.

J. F. DeVoy (C., M. & St. P.)—We have made tests of all the headlights in the United States and have spent a great deal of money getting high power headlights and I want to say right here that you will kill people with the high power headlight. The attorney-general of the state of Wisconsin made us install high power headlights at a cost of between $60,000 and $70,000. The headlight is safest when it acts as a marker and what we want to do is to get this business under federal regulation as soon as possible.

Secretary Taylor—I move that the committee present its recommendations before January, 1914, and that they be printed and distributed to the members at that time so that they will know how to act. This motion was carried.

SUBJECTS.

This report was read by G. W. Wildin, chairman.

After receiving various and numerous suggestions and communications, the committee prepared the following program for consideration:

COMMITTEES SELECTED FOR THE 1914 CONVENTION.

Standing Committee.

Revision of Standards:
Mechanical stokers:

Special Committees.

Autogeneous welding:
  Covering the investigation of electric, gas in its various forms, Thermit, oil and other special methods of welding, with their limitations:
Recommended method of calculating stresses in locomotive boilers:
Locomotive, counterbalancing of; does the Rule 1896 meet modern conditions:
Maintenance of electric equipment, locomotives and motor cars;
Locomotive types:
  Have we reached the limit of Atlantic, ten-wheel and Consolidation types before beginning the development of other and more complicated wheel arrangements:
Cylinder lubrication in connection with superheat:
Motors for railway shops:
  Various types of both A. C. and D. C., and drives, group or individual—their uses and limitations:
Superheater locomotives, with special reference to design of front-end appliances:
Proper location and clearances of side bearings on locomotive-tender trucks, both forward and rear:
Tonnage rating of locomotives—the most practical method:

Individual Papers.

Has the increased weight of modern locomotives brought a correspondingly increased efficiency:
Piston valves, best types and proportions with superheat:
The possible reduction of reciprocating parts on a locomotive, with attendant results:

Topical Discussion.

Packing rings for pistons and valves in connection with superheat:
Locomotive frames, material for:
Cylinder lubrication, graphite:
Tools and machinery, the safeguarding of:

Subjects Suggested Would Be Suitable and Desirable for Reports of Committees.

Air-brake and signal equipment.
Ash pans, design of.
Boilers, design and inspection of.
Boilers, washing and filling.
Cast iron, substitution of for brass on locomotives.
Cylinders, use of cast iron in.
Educating firemen and engineers, recent method.
Electrification.
Exhaust nozzles.
Fire-box arrangement, the best for oil-burning locomotives.
Forgings for driving and engine-truck axles.
Flues, standard spacing of.
Fuel economies.
Grates for locomotives.
Headlights.
Locomotives, electric.
Locomotives, design of trailing trucks.
Locomotives, internal-combustion.
Locomotives, Mallet.
Locomotive performance.
Locomotives, rating of.
Locomotive tenders, standard center plates.
Locomotives, steam versus electric.
Locomotives, three-cylinder.

Locomotives, uniform specification for material.
Lubrication, flange.
Lumber, specifications.
Metal, excess amount purchased account of patterns too large or wrong.
Motor cars, comparison McKeen and General Electric.
Motors, variable-speed.
Painting locomotives.
Power versus weight.
Repairs, cost of locomotives.
Rods, main and side.
Safety appliances.
Safety on railroads.
Shops, electric drive in.
Shops, locomotive-repair, cost of.
Smoke prevention.
Stay bolts, flexible.
Steel, alloy and heat-treated.
Tender derailment.
Tender, largest capacity to be carried on two four-wheel trucks.
Tinware, design.
Tires—shrinkage, contour, specifications.
Ton-mile statistics.
Tool steel.
Tubes, leak in.
Tubes, length.
Valve gear.
Wheel loads.
Boilers, washing and filling.
Drawbars and buffers.
Examinations, progressive.
Gas producer in railroad shops.
Locomotives, cleaning of, safety first.
Locomotive coaling stations and ash pits.
Locomotive fuel, anthracite as a.
Oil burning, effects of with and without arch, tubes or superheater.
Safety valves.
Tubes, leaks in.

FRIDAY, JUNE 13.

SPECIFICATIONS FOR MATERIALS USED IN LOCOMOTIVE CONSTRUCTION.

The committee on specifications for materials used in locomotive construction was instructed to consider the specifications of the American Society for Testing Materials for lap welded and seamless steel boiler tubes, with a view of harmonizing the specifications of that association and this association.

After conferring with subcommittee "X" of the American Society for Testing Materials, the specifications which follow have been prepared covering lap welded and steel boiler tubes. These specifications do not differ greatly from those of the American Society for Testing Materials. They have, however, been amplified by including arch tubes and the large superheater tubes, instead of being confined to tubes of 2½ inches in diameter and less. The paragraph describing the method of making flange test has been introduced, and some other changes of a minor nature made.

As a matter of information, the specifications of the American Society for Testing Materials as originally submitted to your committee are given as an appendix.

Committee: W. C. A. HENRY (Chairman), H. T. BENTLEY, H. E. SMITH, FRANK ZELENY, A. G. TRUMBULL.

Specifications for Lap-Welded and Seamless Steel Boiler Tubes, Safe Ends, and Arch Tubes.

I. Manufacture.

1. The steel shall be made by the open-hearth process.

II. Chemical Properties and Tests.

2. The steel shall conform to the following requirements as to chemical composition.

Carbon	0.08—0.18 per cent
Manganese	0.30—0.50 per cent
Phosphorus	not over 0.04 per cent
Sulphur	not over 0.045 per cent

3. (a) Analyses of two tubes in each lot of 250 or less may be made by the purchaser, which shall conform to the requirements specified in Section 2. Drillings for analyses shall be taken from several points around each tube.

(b) If the analysis of only one tube does not conform to the requirements specified, analyses of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

III. Physical Properties and Tests.

4. (a) A test specimen not less than 4 inches in length shall have a flange turned over at right angles to the body of the tubes without showing cracks or flaws. This flange as measured from the outside of the tube shall be ⅜ inch wide for tubes 2½ inches or less outside diameter, and ½ inch wide for tubes larger than 2½ inches outside diameter.

(b) In making the flange test, it is recommended that the flaring tool and die block as shown be used.

5. A test specimen 4 inches in length shall stand hammering flat until the inside walls are in contact, without cracking at the edges or elsewhere. For lap-welded tubes, care shall be taken that the weld is not located at the point of maximum bending.

6. A test specimen 2½ inches in length shall stand crushing longitudinally until the outside folds of metal are in contact, without showing cracks or flaws.

7. Tubes under 5 inches in diameter shall stand an internal hydraulic pressure of 1,000 pounds per square inch, and tubes 5 inches in diameter or over an internal hydraulic pressure of 800 pounds per square inch.

8. (a) Test specimens shall consist of sections cut from tubes selected by the inspector representing the purchaser from the lot offered for shipment. They shall be smooth on the ends and free from burrs.

(b) All specimens shall be tested cold.

9. One flange, one flattening and one crush test shall be made from each of two tubes in each lot of 250 or less. Each tube shall be subjected to the hydraulic test.

10. If the results of the physical tests of only one tube from any lot do not conform to the requirements specified in Sections 4, 5, or 6, retests of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

IV. Standard Weights.

11. The standard weights for tubes of various outside diameters and thicknesses are as follows:

Outside Diameter.	Thickness (Inches). .095	0.110	0.125	0.135	0.150	0.165	0.180
Inches.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
1.75	1.68	1.93	2.17	2.33	2.56	....	....
2.00	1.93	2.22	2.50	2.69	2.96	....	....
2.25	2.19	2.51	2.84	3.05	3.36	....	....
2.50	2.44	2.81	3.17	3.41	3.77	4.09	4.41
3.00	....	3.40	3.84	4.13	4.57	4.93	5.36
3.50	....	....	4.51	4.85	5.37	5.81	6.31
4.00	....	....	....	5.57	6.17	6.76	7.26
4.50	....	....	....	....	6.97	7.64	8.30
5.00	....	....	....	....	7.77	8.52	9.27
5.25	....	....	....	....	8.17	8.96	9.75
5.375	....	....	....	....	8.37	9.18	9.99
5.50	....	....	....	....	8.57	9.40	10.23
6.00	....	....	....	....	9.37	10.28	11.19

12. The weight of the tubes shall not vary more than 5 per cent from that specified in Section 11.

V. Workmanship and Finish.

13. (a) The finished tubes shall be circular within 0.02 inch, and the mean outside diameter shall not vary more than 0.015 inch from the size ordered. The thickness at any point shall not vary more than 10 per cent from that specified. The length shall not be less, but may be 0.125 inch more than that ordered.

14. The finished tubes shall be free from injurious defects and shall have a workmanlike finish. They shall be free from kinks, bends and buckles.

VI. Marking.

15. The name or brand of the manufacturer and "Tested at 1,000 pounds" for tubes from 0.125 to 0.180 inch, thickness of material, or "Tested at 900 pounds," for tubes less than 0.125 inch thickness of material, shall be legibly stenciled in white on each tube.

VII. Inspection and Rejection.

16. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the tubes ordered. The manufacture shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the tubes are being furnished in accordance with these specifications. All tests except check analyses and inspection shall be made at the place of manufacture prior to shipment unless otherwise specified, and are to be so conducted as not to interfere unnecessarily with the operation of the works.

17. (a) Tubes when inserted in the boiler shall stand expanding and beading without showing cracks or flaws, or opening at the weld. Tubes which fail in this manner will be rejected and the manufacturer shall be notified.

17. (b) Unless otherwise specified, any rejection based on tests made in accordance with Section 3 shall be reported within five working days from the receipt of samples.

18. Samples tested in accordance with Section 3, which represents rejected tubes, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the test the manufacturer may make claim for a rehearing within that time.

F. F. Gaines—I move that the report be referred to letter ballot for adoption as recommended practice. This motion was carried.

SUPERHEATER LOCOMOTIVES.

The committee regrets that the work done during the year has not been sufficient to warrant a full report. However, much has been done, and therefore the committee decided to present further report of progress.

Since the last report there has been an increase in the number of locomotives in the United States and Canada using superheated steam

to 8,822, or more than 100 per cent. Reports from the users indicate that they have been uniformly satisfactory. The troubles that were feared with packing and valves, due to the high temperature of superheated steam, have not developed to any great degree, and where there has been any trouble it has been overcome largely, if not entirely, by the use of good material for the parts in question. It is conceded generally that it is necessary to have cylinders, cylinder bushings, valves and valve bushings made of close-grained iron rather harder than is absolutely necessary when using saturated steam, and that iron low in phosphorus and silicon is desirable.

The committee has not been able to determine any definite figure on the comparative cost of maintaining superheated and saturated steam locomotives, but the general consensus of opinion seems to be that the increase, if any, in the cost of maintenance is not going to be of sufficient moment to influence the question one way or the other.

During the year the Pennsylvania Railroad started a series of tests contemplating the comparison of two Atlantic type locomotives, two Pacific and two Consolidation locomotives, of modern size, one of each type equipped with Schmidt superheater, and the other using saturated steam. The tests of the Atlantic and Pacific type locomotives have been completed, and copy of report upon the Atlantic type locomotive is given in complete detail in this report. The work on the Pacific and Consolidation type locomotives is not yet in shape as to warrant figures being given out, but at least a résumé of the results will be given in next year's report.

Committee: J. T. Wallis (Chairman), C. H. Hogan, R. W. Bell, Thomas Roope, W. J. Tollerton, H. H. Vaughan, J. R. Gould.

The report of tests referred to above is a voluminous one, being a book of 193 pages. In a future edition of the *Railway Master Mechanic* we expect to publish some of the important points covered. The conclusions are as follows:

CONCLUSIONS.

Boiler.

1. Previous tests have indicated, and the results obtained with this locomotive confirm the conclusion, that the locomotive boiler surfaces absorb a fixed amount of heat from each cubic foot or from each pound of the gases of combustion flowing past them, and the increase in evaporation is due to the increase in weight or quantity of the gases of combustion, and to no other cause. This being true, the capacity of the boiler is fixed by limitations of combustion upon the grate, and not by a failure of the boiler surfaces to absorb heat.

2. The limit of boiler capacity with this locomotive was reached at a rate of coal burning of approximately 7,000 pounds per hour, and, therefore, whether or not a stoker is required to efficiently handle this locomotive will depend upon the length of grades to be ascended and the requirements of continual heavy loading.

3. These tests furnish us with additional information on flue lengths which is of value. The short tubes show an advantage in activity of combustion and also in rapidity of evaporation, with an attending lower efficiency of the boiler, and we conclude that:

(a) The most desirable length of tube depends upon how much the designer is willing to sacrifice in boiler efficiency to obtain rapid evaporation with some loss of heat.

(b) There is a rapid decrease of temperature in the tubes for a distance of three or four feet from the fire box end, after which the temperature drop is more gradual until, with this short tube, the curve of tube temperature becomes flat toward the smoke box end, and therefore the heat transfer at the fire box end of this tube is much higher than at the smoke box end.

(c) The temperature of the superheater flue is in all cases from 100 to 200 degrees higher than the temperature in the boiler tube. This is probably due to the larger volume of gases passing a hot tube surface, namely, the superheater units.

(d) Observations made on other locomotives indicate that there is little if any difference in temperature of flues as far as their location in the sheet is concerned.

(e) From the boiler efficiency obtained with this locomotive, the form of the curve of temperature drop in the tubes, and the high smoke box temperature, slightly longer tubes seem desirable.

Engines.

4. From paragraphs 95, 96, 98 and 99 we conclude, for a given cut-off, the water rate decreases with an increase in superheat, the rate of decrease apparently being faster at the shorter cut-offs. For a given water rate the superheat increases with an increase in cut-off, the increase in cut-off causing a higher draft on the fire and an attending increase in power output.

5. Remembering that 30 per cent less weight of steam is used when superheating, it is this fact which in a large measure results in a lower amount of heat discharged through the exhaust. A smaller total quantity of heat is supplied and a larger percentage utilized, and therefore an economy is brought about by the reduction of waste heat through the exhaust.

6. In exhausting steam from a locomotive cylinder it has been found that, for the same work done, less than one-half the least back pressure is required as compared with these cylinders operating with saturated steam.

Locomotive.

7. In Bulletin 19, when discussing the K29 locomotive, conclusion 9 on page 144 was drawn that an economy in water approximately 30 per cent and in coal of between 20 and 30 per cent might be expected when using highly superheated steam with a boiler pressure of 200 pounds per square inch. This conclusion is confirmed by these E6s tests, and the additional conclusion seems to be warranted that, when approaching the limit of the saturated steam locomotive, a saving as high as 50 per cent may be expected, and that the application of the superheater justifies itself by an increased maximum capacity over the saturated steam locomotive of not less than 30 per cent.

8. If we assume a limit of 1,400 dynamometer horse-power for the E6 locomotive, the E6s may be expected to produce 1,850 dynamometer horse-power, or an increase of 32 per cent; this marks the increased power which may be expected by superheating.

9. The application of the superheater to this locomotive increases its economy from a minimum of 23 per cent to a maximum of 46 per cent, the economy increasing with the increased power required of the locomotive.

10. It was found that 30 per cent higher capacity was derived from the E6s locomotive when using superheated steam than with the same size and type of locomotive using saturated steam.

11. When conditions are such that the starting of trains, and low speeds up to approximately 30 miles per hour, are not factors in tonnage rating, the application of the superheater to a passenger locomotive permits an increase of rating of approximately 30 per cent. If the starting of heavy trains and low speeds of operation are factors in establishing the tonnage rating, there is nothing in these tests to indicate that the superheater locomotive should have a lower rating than the saturated steam locomotive.

12. From the results obtained in the tests we believe that any locomotive in being converted from saturated to superheated steam should, with the application of the superheater, have enlarged cylinders, the results indicating that for the purpose of obtaining maximum economy the extent of the cylinder enlargement should be such that the maximum indicated horse-power may be developed at a cut-off not exceeding 30 per cent.

Recommendations.

1. In building additional locomotives of this type, where the maximum weight on drivers is limited to 65,000 pounds, we would recommend that some form of nozzle be designed and tried out to give better draft conditions than the present circular nozzle.

2. This locomotive seems to be of sufficient size to require a power type of reversing gear, and we would recommend the application of the screw reverse gear arrangement, and the elimination of the present offset in the reach rod which requires a slot and roller.

3. We would recommend an enlargement of the cylinders in accordance with conclusions arrived at.

4. If the present diameter of fire tubes is to be maintained in the boiler, we would recommend an increase in the tube length; this increase can be obtained by a redesign at either the front or back tube sheets, or both.

5. From other tests which have been made at the plant, we believe that the size of the piston valve of this locomotive can be reduced to the standard size, which will be adopted.

6. The centre bearer of the grate, which is unusually wide, could to advantage be reduced in width to increase the active grate area.

Discussion.

H. T. Bentley—I think that this report should be taken home ad studied, and I move that a vote of thanks be given to Messrs. Wallis and Young and the Pennsylvania Railroad for this splendid paper. This motion was carried.

H. H. Vaughan—I think the diagrams No. 63 and 64 on page 121 (coal per dynamometer horse-power hour and steam per dynamometer horse-power hour) are very remarkable, as they show the gain by using superheater locomotives. The saturated curve is flat, while the superheater is still increasing.

Henry Fowler (Midland Ry. of Eng.)—We shall welcome on our side these exhaustive tests. There is one point—it seems that when they opened the fire door the efficiency went up. It has always been our idea to keep the door closed as promoting the best condition.

C. D. Young—This is the second locomotive on which we have noticed this characteristic when the grate surface is being forced to a burning rate of 150 pounds of coal per square foot of grate. The thickness of the fire was 18 inches at the door to 10 inches at the flue sheet.

THREE-CYLINDER LOCOMOTIVES.

This was an individual paper read by J. Snowden Bell, associate member, and will be published in a later issue.

SPECIAL ALLOYS AND HEAT-TREATED STEEL IN LOCOMOTIVE CONSTRUCTION.

A circular of inquiry, dated October 26, 1912, was sent to the various members, outlining a series of questions, Nos. 1 to 17, inclusive, in order to obtain information concerning the introduction of this material for details of locomotive construction. Replies were received from twenty-six railroads, which cover an ownership of approximately 25,266 locomotives.

From the information received and that which has been in the possession of the committee it was deemed unwise at this time to make other than a progress report, but submit the following for the information of the members.

A few roads are using and others making experimental investigation of heat-treated carbon steel in locomotive frames, main and parallel rods and miscellaneous parts. Material of heat-treated carbon boiler and fire-box steel does not seem to have been tried. Five roads are using heat-treated carbon steel springs. Five roads are using heat-treated carbon wheels and tires. Carbon heat-treated steel for piston rods, axles and crank pins is the more generally used of the treated steels, and ten roads in all are doing more or less work with this class of material.

Question 2.

Do you use any alloy steels in locomotive construction?

1. Frames and steel castings.
2. Main and parallel rods.
3. Piston rods and motion parts.
4. Axles and crank pins.
5. Boiler sheets.
6. Tires and wheels.
7. Springs.
8. Miscellaneous parts.
9. Cast iron.

In reply to this question, please make separation between the following classifications and any others which you may be using.

a. Silicon.
b. Silico-manganese.
c. Vanadium.
d. Chrom-vanadium.
e. Chrome.
f. Nickel.
g. Chrom-nickel.
h. Chrom-nickel-vanadium.
i. Titanium.

The replies as to the use of alloy steels in locomotive construction are so varied that it can only be stated that alloy steels are being used to some extent, and from the replies, the greatest quantity of alloy steels seems to be confined to locomtive frames, main and parallel rods, piston rods, axles and crank pins, although some roads are using alloy steels for springs. One road is making an investigation of fire-box steel. The tabulation would seem to indicate that the use of vanadium is quite extensive in frame material, eight roads making use of this element. For main rods, piston rods, axles and crank pins both vanadium and chrom-vanadium, with some nickel, is being used, and in spring material some silico-manganese, vanadium, chrom-vanadium and nickel have been employed. Some use has been made of vanadium and chrom-vanadium in cast iron, there being five roads making experiments with this material.

In the use of alloy steels in locomotive frame, five roads require heat treatment, whereas four do not, and for main and parallel rods, piston rods, axles and crank pins there seems to be about an equal number requiring heat treatment as compared with those which do not require heat treatment of the material. For tires and springs the majority of the roads do not require special treatment, and for boiler steel, cast iron and miscellaneous parts no treatment is required by any one.

The tabulation showing answers to question requesting chemical requirements for various materials used with heat-treated carbon and alloy steels, gives some interesting information, and seems to indicate tentatively that the following represents average existing practice:

PISTON RODS, AXLES AND CRANK PINS.

	Heat Treated Carbon Steel.	Alloy Steel.
Carbon	.45 to .60	.30 to .40
Manganese	.45 to .70	.40 to .65
Phosphorus, not over	.05	.05
Sulphur, not over	.05	.05
Silicon	.....	.15 to .30
Vanadium, not less than	.....	.16
Chrom	.....	.90 to 1.10

So little data were obtained for locomotive frames, tires, wheels and springs that a typical analysis requirement could not be abstracted.

For the physical requirements the practice from the replies seems to indicate the following:

PISTON RODS, AXLES AND CRANK PINS.

	Elastic Limit Lbs. Per Sq. In.	Ultimate Lbs. per Sq. In.	Elong. Per Cent in 2 In.	Per cent Reduc. of Area.
Heat Treated Carbon.	50,000 Min.	85,000 Min.	22.0	45.0
Alloy	80,000 Min.	100,000 Min.	20.0	50.0

But one reply was received from the railroads enclosing characteristic photo-micrographs, and so little metallography work has been done apparently that for the present it does not seem wise to consider photo-micrographs in conjunction with any specifications, although the committee feels that it would be wise for members to take up the study along this line.

Replies seem to indicate that the matter of heat treatment is left largely to the manufacturers who are furnishing the material. The Pennsylvania Railroad practice for heat-treated carbon steel for piston rods, axles and crank pins is approximate, depending upon the normal carbon of their specifications, namely, heating between 1,500° and 1,600° F. and quenching in water and drawings to a temperature of between 1,050° and 1,150° F., the material not being permitted to get entirely cold between quench and temper.

Replies seem to indicate that in a general way the use of heat-treated carbon and alloy steels has resulted in satisfactory service, increased mileage having been obtained from the materials with apparently fewer failures, although in the majority of the cases the material has not been in service long enough to make a fair reply.

Seven roads replied that they did not require any heat-treated carbon or alloy steel axles and crank pins to be drilled, whereas four roads are at this time requiring drilling for the proper treatment. Present tendency seems to be toward requiring the drilling of shafts of large diameters.

Most of the members have not found it desirable to use alloy steels and heat-treated carbon steels in designs where excessive vibration or shock is not expected, five roads stating that this is their present practice. One member is using this material for springs, one for side rods and one for all machinery parts for high-speed passenger locomotives.

Lack of uniformity exists as to the method of determining if the desired physical properties of the individually heat-treated piece has been secured. A majority of the answers indicate that the test piece, however selected, is sufficient to represent the individually heat-treated object. One road is, however, requiring a test piece from each object treated, without regard to the size of the quenching or annealing charge.

All members replying to the question indicate that it is desirable for the Association to have a specification for heat-treated carbon and alloy steels. These replies would seem to indicate that there is a desire upon the part of the members to increase the scope of the use of these materials.

Replies seem to indicate that heat-treated carbon steel can be obtained at a slight advance in price, whereas alloy steels may be purchased at an increased cost, approximately double that of the plain carbon steel, heat-treated.

In view of the foregoing, the committee does not deem it wise to make any definite recommendations at this time, and suggests that the committee be continued with a view of further investigating this subject as more information is developed. If such a course is pursued, the committee will tentatively outline specifications for such heat-treated carbon and alloy steels as seem wise in view of the development in the use of the materials and present them for discussion to the members during the coming year.

Committee: C. D. Young (Chairman), Henry Bartlett, S. M. Vauclain, H. B. Hunt, J. C. Little.

After reading the report, Mr. Young suggested that the tables and illustrations be omitted from the proceedings, as there had been some discrepancy between the data of the manufacturers and the roads.

Discussion.

F. F. Gaines (Cent. of Ga.)—We have had trouble with heat-treated axles breaking off after a few weeks' service, and it seems it must be due to the method of heat treatment.

C. D. Young (Penn.)—Others have had the same experience. The Pennsylvania has been using heat-treated axles since the first electric locomotives, and if the treatment is not properly done, it may make the material worse. The Pennsylvania is installing a heat-treating plant and we expect to subject the punching charges not only to a specimen test, but also to a drop test on each piece. Heat treatment will make poor steel worse, but will improve good steel.

Charles Fuller (Union Pacific)—We have had Mr. Gaines' experience as to breaking.

J. F. DeVoy (C., M. & St. P.)—We have tried to use heat-treated axles on about 200 locomotives and I feel free to say that under no circumstances would I put heat-treated axles under locomotives. We planed the broken axles down and when we get inside cracks appeared and pieces broke off. A proper inspection of heat-treated axles cannot be had.

The report was referred to the incoming executive committee.

SMOKE PREVENTION.

Two years ago the committee handling this subject reported on an experimental smoke-washing device for roundhouses. At present several members are experimenting with this and one quite extensive plant is under construction, and the committee hopes to be able to embody some practical information along this line in our report at the next convention.

Several members of the committee were on a special committee appointed by the General Managers' Association of Chicago to determine the advantages of steam jets in locomotive fire boxes as an aid to smoke prevention, and it was on their recommendation that their report be transmitted to this committee for the use of the convention and publication in its proceedings.

The chairman acknowledges his indebtedness particularly to the president of this Association for his careful test and its valuable deductions, and begs leave to submit it in full.

Committee: E. W. Pratt (Chairman), J. F. DeVoy, W. C. Hayes, T. R. Cook, M. K. Barnum.

These smoke-abatement tests were made at the Altoona testing plant of the Pennsylvania to determine the merits and proper application

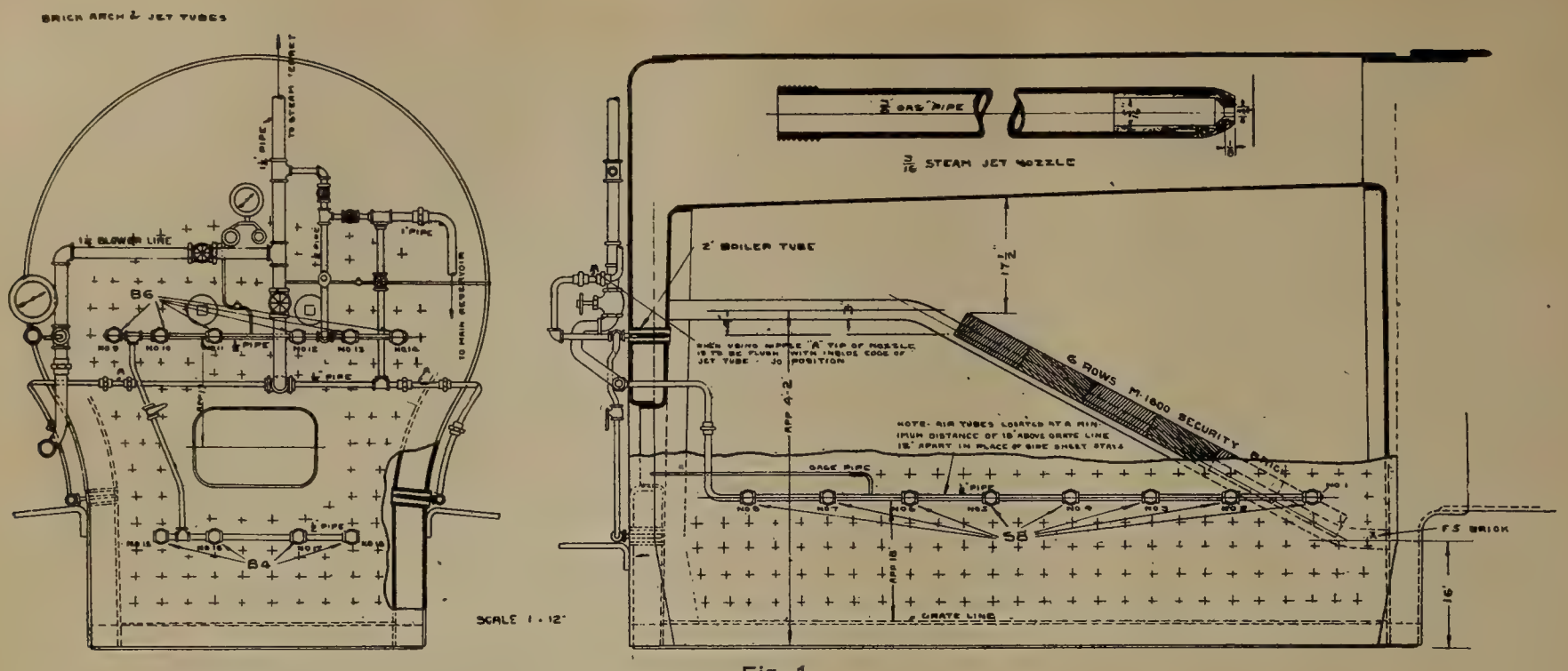


Fig. 1.

of steam jet combustion tubes in a locomotive fire box for abating smoke, both with and without a brick arch, the special purpose being the development of a specification applicable to locomotives operating in the city of Chicago. The tests were made at the solicitation of the committee of the General Managers' Association, which is working in conjunction with the Chicago Association of Commerce Committee of Investigation of Smoke Abatement and Electrification of Railway Terminals.

In brief, the results show that if from four to six pounds of air per pound of coal fired is delivered over the fire by steam jet tubes, the emission of smoke will be reduced to a very low amount, and that while the brick arch is a benefit, particularly while the locomotive is running, the steam jet combustion tube is of value either with or without a brick arch.

Class B29 locomotive No. 7042 was selected for the tests as being representative of a large class of shifting engines in service in Chicago.

The locomotive was equipped with a Security brick arch consisting of six rows of bricks supported on two 3-inch tubes with a 5-inch gap between the flue sheet and the front of the arch, as illustrated in Fig. 1.

The steam jet combustion tubes were applied in accordance with Fig. 1. There were eight tubes along each side of the fire box, six above the fire door on the back head, and four below the fire door. The tubes consisted of pieces of 2-inch boiler tubing, approximately 6 inches long inserted in place of stay bolts, and each tube was provided with a $\frac{3}{16}$-inch steam nozzle connected to a ½-inch steam line. Separate valves controlled the steam admission to each set of tubes, and the piping was so arranged that the position of the nozzles in the tubes could be changed as desired. Arrangement was also made to use air in the nozzles in place of steam. A gauge connection to each line was made so that the desired pressure in the line could be maintained.

The blower line consisted of a 1¼-inch steam pipe from the steam turret to the smoke-box connection, which latter connected to the exhaust nozzle by a 1-inch pipe. The blower was of the double tip nozzle type and is shown in Fig. 2. Steam admission to the blower line was controlled by a quick-opening flat disk valve, which gave any desired pressure up to a maximum of 130 pounds, as indicated on a steam gauge connected to the line just below the valve, Fig. 1. This valve is the type used on the Chicago & North Western Railroad and is shown in Fig. 3.

The fire door was equipped with an adjustable damper and deflector. The damper was set with an effective opening of 10 square inches, and the deflector at an angle of 30 degrees with the door, throughout the tests.

The smoke box was of the self-cleaning type, with adjustable lift pipe and deflector.

METHOD OF MAKING THE TESTS.

In order to obtain conditions similar to exacting yard service, the locomotive was run for seven minutes at a drawbar pull of about 15,000 pounds at twelve miles per hour (eighty r. p. m., reverse lever in twenty-fourth notch, full throttle), and then shut off and allowed to stand for three minutes with the blower on full. The rated tractive effort of this locomotive is 26,517, so that 56 per cent of the rated tractive effort was delivered, which made the locomotive work very hard. The minimum boiler pressure allowed was 170 pounds, or a variation of ten pounds from the rated pressure of 180 pounds. To get a good average for each condition, four consecutive running and standing tests were made to constitute a cycle or set of tests.

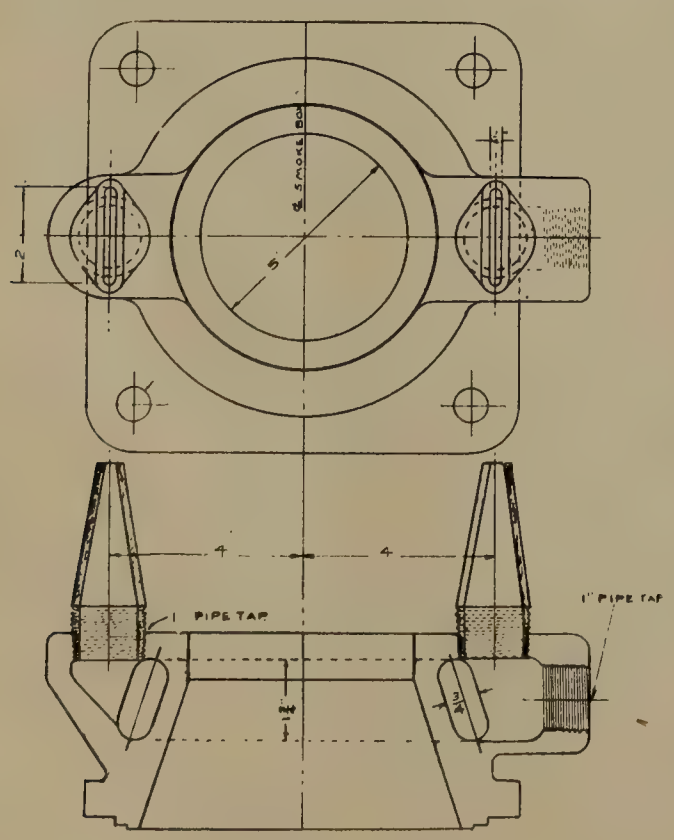


Fig. 2—Double Tip Blower.

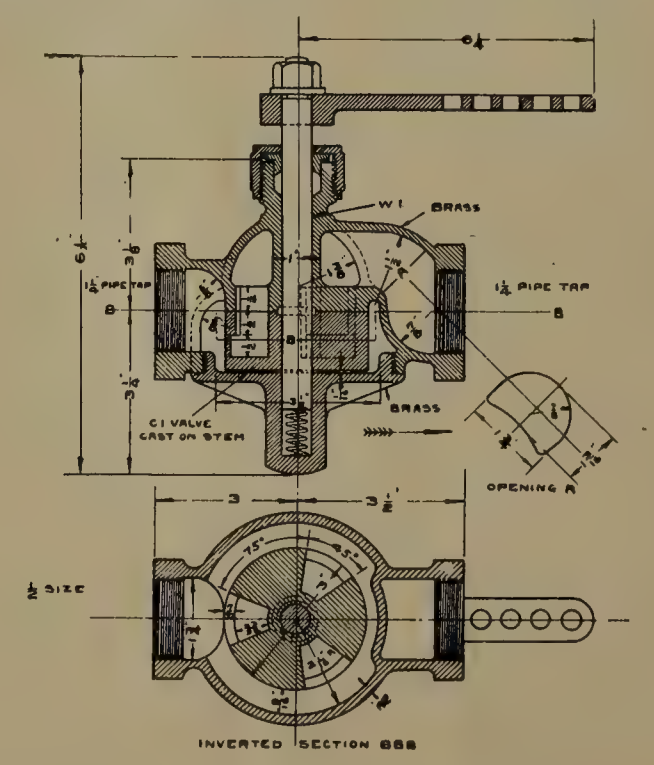


Fig. 3—C. & N. W. 1¼-Inch Blower Valve.

While running, careful and uniform firing was insisted upon with a light, sloping fire, but as soon as the throttle was closed the fireman promptly threw a stated amount of coal under the front of the arch, to make plenty of smoke. One, four, none and six shovelfuls of coal were used for this purpose on the four stops, and is included in the coal used for each test. The standing smoke may be considered as the result of careless firing.

The above cycle of tests was made with each of the various arrangements of steam jet tubes, selected to give data as to the best location of the tubes, the best location of the nozzles in the tubes, and the most desirable amount of air and steam injected by the tubes, with and without the brick arch.

Records of blower pressure, steam-jet pressures and the time the jets were open when running and when standing, coal used, fire-box temperature and drawbar pull were kept, and continuous smoke readings, according to the Ringelmann method, were made from the beginning of each running test until one minute after the stop. It was originally intended that smoke readings would be made at intervals of ten seconds for three minutes after the test stopped. It was found, however, that this time would be too long and would not really represent the average smoke conditions after the stop. Time was then changed to one minute after the stop. The results are given in percentages; for example, 20 per cent smoke being No. 1 on the Ringelmann scale.

The amount of air entering the fire box through the ash pan, fire door and steam-jet tubes was determined by the use of anemometers.

The velocity of the air entering the ash pan was determined, only while running, by the use of an anemometer fitted into a funnel. The funnel was placed in six different positions around the pan and readings taken for one minute. The average velocity thus determined was used to compute the volume of air entering the ash pan.

The velocity of air through the fire-door openings was determined, only while the locomotive was standing, in a similar manner, except that the funnel was tight-fitting around the damper slide.

The volume of air injected by the steam-jet tubes, both when running and when standing, was determined from a calibration made on one tube with all of the different positions and pressures, using a wind box and anemometer. The wind box was air tight, being fitted over the steam-jet line, and all air was taken through the anemometer.

The sparks discharged from the stack were caught in a spark catcher erected on the roof on the testing plant.

After each set of tests the sparks collected were swept up and weighed. Analyses of eleven representative samples of these sparks were made. Analyses of the flue gas were made from samples representing the average of the running and standing tests for every cycle.

The brick arch was in place on about half the tests and was removed for about half the tests. On a few tests the gap between the arch and flue sheet was closed.

Coal.

The coal used throughout the tests (except in nine efficiency tests) was furnished by the Superior Coal Company from the Benld Mine in Macoupin County, Illinois, and is representative of the coal used in the Chicago district. Two carloads of this coal were used, the proximate analyses being almost identical. The following table gives the two analyses and the corresponding test numbers:

Test No.	Fixed Carbon	Volatile Matter	Moisture	Ash	Sulphur Determined Separately
2501 —2500.25	37.73	37.14	8.99	16.14	6.15
2500.28—2500.78	37.47	38.41	9.89	12.23	5.57

The noticeable features of this coal are the high ash, sulphur and moisture, which make it a very dirty, clinkering coal, of comparatively low heating value. The calorific values of the two carloads were 11,671 and 12,884 B. t. u. per pound dry coal, respectively.

Efficiency Tests.

After the best arrangement of steam-jet tubes, with and without the arch, had been determined, a series of efficiency tests was run at the same speed and cut-off, both with and without the arch, to determine the efficiency of the boiler and locomotive with the steam-jet tubes as compared with the same locomotive without the tubes. These tests were run for one hour each.

The coal used on these tests was from the Penn Gas Coal Company, Irwin, Pa., and the analysis was as follows:

Although the operating pressure was the maximum practicable, the amount of air injected by the jet tubes was sufficient to check the direct draft on the fire, and therefore prevent too rapid combustion.

To determine the value and economy of the blower used, it was compared with two other blowers as regards steam consumption and vacuum produced. The double-tip stack blower had tips so arranged that the tube jets would meet about half way up the center of the stack, and they had precisely the same area of opening as the double-tip blower used in the smoke test. The multiple-tip blower was used for comparison. All three blowers had the same blower valve and line from the steam turret. It is evident that the multiple-tip blower produces the best vacuum, with the double-tip blower a close second. The stack blower gives a very poor vacuum. The multiple-tip blower gives the most uniform pressure, thereby filling the stack to better advantage than the others.

The double-tip stack blower and the double-tip blower have the same steam consumption and the multiple-tip blower has a slightly lower steam consumption.

The blower valve used in the tests was a quick-opening flat disk valve, operated by a lever handle, as is used on the Chicago & North Western Railroad. It is shown in Fig. 3. A "Villoco" quick-opening blower valve was tried on the same blower line. This valve was of 1-inch pipe size, but it gave a maximum pressure of 120 pounds in the 1¼-inch blower line. It was reasonably easy to operate, but gave only two different pressures, namely, 100 pounds and 115 pounds, in the blower line at its intermediate and full open positions, respectively. An ordinary 1¼-inch Globe valve was next put in the blower line. It gave a maximum pressure of 125 pounds.

Three firing-up tests were made with a cold boiler to determine the efficiency of the steam jets with a low fire-box temperature. The following table gives results:

Test No.	Jet Tubes In Use	Time to Obtain Full Boiler Pressure Minutes.	Cubic Feet of Air Per Minute From Jets.	Maximum Smoke No.	Average Smoke in Per Cent.	Corresponding Smoke in Per Cent. Fig. 10.
1		68		4	28	25
2	B6	68	1,670	2	20	8
3*	B6	74	1,525	2	16	10

* Double Tip Stack Blower.

The double-tip nozzle blower was used on the first two tests, and the blower was the same on all three. The results show that the steam jets are capable of reducing smoke even when the fire-box temperature is low, but they are not as efficient as when it is high, as might be expected. Hence they would be of service at all times in shifting service, but in greater degree when the fire-box temperature is high.

From the results outlined in the previous paragraphs, two things are apparent: First, that a large quantity of air must be injected over the fire by the steam-jet tubes to reduce smoke properly, and, second, that this air should be injected with the least amount of steam practicable. To determine the proper arrangement of the steam-jet tubes to fulfill these requirements, complete air and steam calibrations were made upon ⅛-inch, $\frac{3}{16}$-inch and ¼-inch nominal diameter steam nozzles in the 2-inch outside diameter jet tube.

The air calibrations with and without the blower show that it is possible to move the nozzle from the inner end of the tube to a position 8½ inches from the inside edge, or approximately 2½ inches beyond the outer end of the tube, and in case of the ¼-inch nozzle, 3½ inches beyond the outer end, with a continually increasing quantity of air injected into the fire box. Beyond that position the quantity of air falls off, probably due to the greater friction of the steam in the tube and the striking of the outer edge of the jet of steam on the fire-box sides. The indications are that the most efficient position is where the jet of steam expands and completely fills the tube just before reaching the inner end of the tube. The larger the nozzle, the greater the quantity of air injected. The steam consumption of the three nozzles is proportional to the absolute pressure in each case. According to Napier's rule, it is also proportional to the area of the nozzle, and the curves in general indicate this, but not precisely, because the diameters of the nozzles are nominal only. They are correct only within the limits of ordinary machine shop practice.

The ⅛-inch nozzle is the most efficient of the three, with the $\frac{3}{16}$-inch slightly less efficient and the ¼-inch very much less efficient. All three are more efficient as the operating pressure decreases.

While the ⅛-inch nozzle is most efficient, the $\frac{3}{16}$-inch nozzle is capable of injecting 50 per cent more air with only slightly less efficiency, and, in general, would probably be the desirable nozzle to use.

CONCLUSIONS.

The steam-jet combustion tube has a decided value in reducing smoke under the widely varied conditions of these tests. The air injected by the tube was found to be the greatest factor in reducing smoke, although a small amount of steam seems essential in smoke reduction. When using steam jets, injecting air into the fire box, it was apparent that a greater reduction in smoke was accomplished by their use with improper firing as compared with careful firing.

The fire-box temperature was found to be higher when the arch was in service as compared with the plain fire box, although the data do not consistently show that a reduction in smoke follows increased fire-box temperature. The brick arch showed a considerable reduction of smoke when running, due presumably to higher fire-box temperatures and better mixing of the gases of combustion, while on the standing tests the brick arch showed little if any benefit in the way of smoke reduction when the proper mixture of air and steam is supplied. The steam-jet tubes seem to give the best results in preventing smoke when located so that the injected air and steam meet the flame as high as possible above the fuel bed. If the arch is used, the best results seem to be obtained when the air passes underneath the arch as high as possible above the fuel bed.

The arch gives better results in smoke prevention if it fits tight against the flue sheet. A tight arch, however, has the practical disadvantage of collecting deposits of sparks and eventully closing the lower flues.

An efficient design of smoke-box blower is an important factor in smoke abatement. Air openings in the fire door are of slight assistance in smoke abatement, as they are capable of supplying only about 10 per cent of the air necessary above the fire and a very small percentage of the total air for complete combustion.

Best results were obtained when from 4 to 6 pounds of air per pound of coal fired was injected by the steam tubes from a location in the back head above the fire door. It was found on these tests that the total amount of air, including that which was introduced above the fire, should be not less than 13 pounds per pound of coal for good smoke prevention. The data seem to indicate that the best results can be obtained when the least amount of steam is injected with the greatest amount of air.

The use of the steam-jet tubes results in considerable economy, and in the efficiency tests an increase in evaporation was obtained. The steam-jet tubes apparently reduce the weight of sparks discharged from the stack, but the data were not of a character to firmly establish this point. There is a necessity for a quick-acting, easily operated valve capable of giving reasonable graduations in pressure.

It was found during the tests that the steam nozzles were being worn by the steam, and this accounts for the inability of the steam lines to supply as great a pressure to the jets as desired in some of the later tests. The nozzles were made of brass. The indications are that they should be made of steel and, if necessary, hardened.

The $\frac{3}{16}$-inch diameter steam nozzle seems to be the desirable one to use in a 2-inch tube. There is noise incident to the use of the steam-jet tubes in the most efficient arrangement, and if the steam-jet tubes are located in the cab they should be covered with a $\frac{3}{8}$-inch cast-iron box provided with cast-iron air intake from a point outside the cab, the air intake being provided with a muffler.

Discussion.

W. H. Fetner—The committee says best results are obtained when the arch is tight up against the flue sheet. Our experience has been that we were unable to keep the lower flues clean. However, we get around it by using a spark hopper to take care of the sparks.

E. W. Pratt (C. & N.-W.)—Several railroads in Chicago have equipped a large number of locomotives as outlined in this report. With regard to jet tubes, which the report states should be located in the back head, a number of roads are obtaining very satisfactory results by locating them in the side sheets.

C. F. Giles (L. & N.)—We have applied these devices to two of our engines and they are proving very satisfactory.

ENGINE AND TENDER WHEELS.

The committee has made a careful study of the design of solid carbon wheels for engine truck and tender service, as made by the various steel wheel manufacturers and used by the members of this association.

A complete specification, with full set of drawings covering designs of engine truck and tender wheels, is submitted with this report as Recommendations No. 1 and No. 2, for adoption as Recommended Practice.

In addition to this the committee recommends the adoption of various gauges to be used with cast-iron and steel wheels, as shown in the detail recommendations.

The committee also recommends revising specifications for cast-iron wheels and the drawings of same to agree with the revised and rearranged specifications adopted by the M. C. B. Association, 1912.

In reference to the question of working up specifications and designs for chilled cast-iron wheels for 140,000-pound capacity tenders, no action has been taken, as the question of increased thickness of flange and its relation to frog and guard-rail clearance has not been determined upon, and until such time the committee does not feel warranted in recommending a design for this capacity chilled cast-iron wheels.

RECOMMENDATION No. 1.

Specification for solid wrought carbon steel wheels for locomotive and tender service:

I. Manufacture.

Process.—The steel shall be made by the open-hearth process.

Discard.—A sufficient discard shall be made from the top of each ingot from which the blanks are made to insure freedom from injurious piping and undue segregation.

II. Chemical Properties and Tests.

Chemical Composition.—The steel shall conform to the following requirements as to chemical composition:

	Acid.	Basic.
Carbon	0.60—0.80	0.65—0.85 per cent
Manganese	0.55—0.80	0.55—0.80 per cent
Silicon	0.15—0.35	0.10—0.30 per cent
Phosphorus	Not over 0.05	Not over 0.05 per cent
Sulphur	Not over 0.05	Not over 0.05 per cent

Ladle Analyses.—To determine whether the material conforms to the reqirements specified in Section II, an analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt. A copy of this analysis shall be given to the purchaser or his representative.

Check Analyses.—A check analysis may be made by the purchaser from any one or more wheels representing each melt, and this analysis shall conform to the requirements specified in Section II. A sample may be taken from any one point in the plate, or two samples may be taken, in which case they shall be on radii at right angles to each other. Samples shall not be taken in such a way as to impair the usefulness of the wheel. Drillings for analysis shall be taken by boring entirely through the sample parallel to the axis of the wheel; they shall be clean from scale, oil and other foreign substances. All drillings from any one wheel shall be thoroughly mixed together.

Limits of Segregation.—The segregation of either element of carbon, manganese and phosphorus must not exceed 6 per cent of the ladle test of the same melt or any part forming the thickness of the plate and tread and rim of the wheel.

III. Tolerances.

Wheels should be furnished rough-bored and with faced hubs and have a contour of tread and flange as rolled or machined according to M. M. Recommended Practice, Sheet 1, Fig. 1. They shall conform to dimensions specified on drawings shown on Exhibits A, B and C, herewith, within the following tolerances:

Height of Flange.—The height of flanges should not be more than $\frac{1}{8}$ inch over, and must not be under that specified, or 1 inch.

Thickness of Flange.—The thickness of flange shall not vary more than $\frac{1}{16}$ over or under that specified.

Throat Radius.—The radius of the throat shall not vary more than $\frac{1}{16}$ inch over or under that specified.

Thickness of Rim.—The thickness of rim to be measured between the limit-of-wear groove and the top of the tread, at the point where it joins the fillet at throat of flange. The average thickness of service metal of all wheels in any shipment must not be less than 1¾ inches, measured from the limit-of-wear groove to top of tread. The thickness of rim should in no case be less than $\frac{3}{16}$ inch under that specified.

Width of Rim.—The width of rim shall not be more than $\frac{1}{8}$ inch less nor more than $\frac{1}{8}$ inch over that specified.

Thickness of Plate.—The thickness of the plate of the wheel shall not be less than ¾ inch at the point where the plate joins the fillet at the rim and not less than 1 inch at the point where the plate joins the fillet at the hub. Intermediate minimum thickness to be proportional.

Limit-of-wear Groove.—The limit-of-wear groove to be located as shown on wheel drawings. M. M. Recommended Practice.

Diameter of Bore.—The diameter of rough bore shall not vary more than $\frac{1}{16}$ inch above or below that specified. When not specified, the rough bore shall be ¼ inch less in diameter than the finished bore, subject to the above limitations.

Hub Diameter.—The hub may be either 10 inches or 11 inches in diameter, as specified for tender wheels and outside hub of engine wheels, and 13½ inches and 15 inches in diameter for inside hubs on engine truck wheels. Maximum variation of $\frac{1}{8}$ inch below. The thickness of the wall of the finished bored hub shall not vary more than $\frac{3}{8}$ inch at any two points on the same wheel.

Hub Length.—The length of the hub shall not vary more than $\frac{1}{8}$ inch over or under that specified.

Depression of Hub.—The depression of the hub must be made so that the distance from the outside face of the hub to the line "AB" shall not exceed $1\frac{11}{16}$ inches for tender wheels on 5½-inch axles and under, and $1\frac{7}{16}$ inches for tender wheels on 6 by 11 inch axles. For engine truck wheels the distance from the inside face of the hub to the line "AB" shall not exceed $3\frac{5}{16}$ inches.

Black Spots in Hub.—Black spots will be allowed within 2 inches of the face of the hub, but must not be of such depth that they will not bore out and give clear metal at finished size of bore.

Eccentricity of Bore.—The eccentricity between the tread at its center line and the rough bore shall not exceed 3/64 inch.

Block Marks on Tread.—The maximum height of block marks must not be greater than 1/64 inch.

Rotundity.—All wheels shall be gauged with a ring gauge, and the opening between the gauge and tread at any one point shall not exceed $\frac{1}{16}$ inch.

Plane.—Wheel shall be gauged with a ring gauge placed concentric and perpendicular to the axis of the wheel. All points on the back of the rim equidistant from the center shall be within a variation of $\frac{1}{16}$ inch from the plane of the gauge when so placed.

Tape Sizes.—Wheels shall not vary more than five tapes under nor nine tapes over the size called for.

Mating.—The tape sizes shall be marked in plain figures on each wheel. Wheels must be mated to tape sizes and shipped in pairs.

Gauge.—Gauges and tape used shall be M. M. Recommended Practice, as follows:

Wheel circumference measure, M. M. Recommended Practice, Sheet No. —.

Maximum flange thickness gauge, M. M. Recommended Practice, Sheet No. —.

Minimum flange thickness gauge, M. M. Recommended Practice, Sheet No. —.

Rotundity gauge, M. M. Recommended Practice, Sheet No. —.

Gauge for measuring service metal, M. M. Recommended Practice, Sheet No. —.

Plane gauge, M. M. Recommended Practice, Sheet No. —.

IV. Branding.

The name or brand of the manufacturer, date and serial number, shall be legibly stamped on each wheel in such a way that the wheel may be readily identified. The tape size shall be legibly marked on

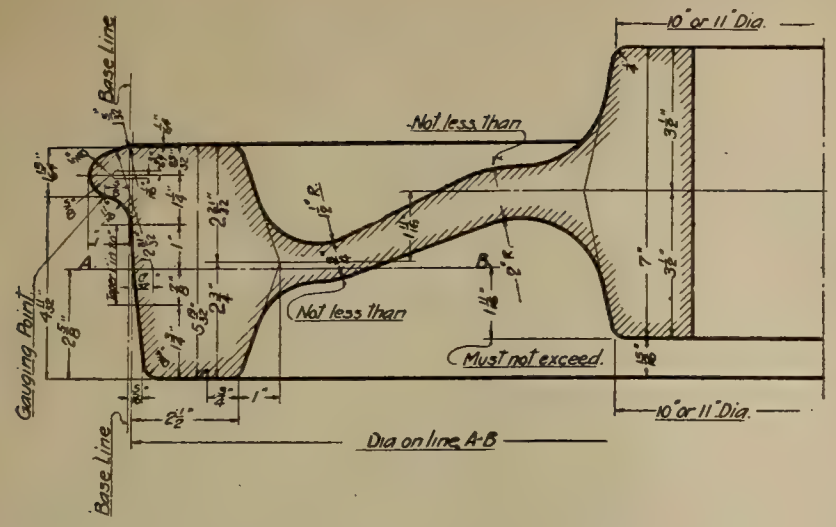


Exhibit A—33, 36 and 38-inch Solid Steel Tender Wheels for 4¼"x8", 5"x9" and 5½"x10" Axles.

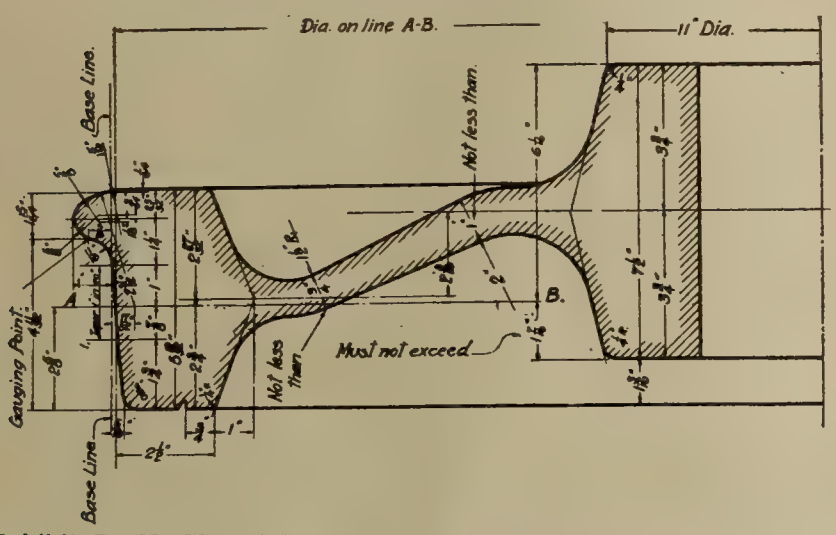


Exhibit B—33, 36 and 38-inch Solid Steel Wheel for 6"x11" Axles.

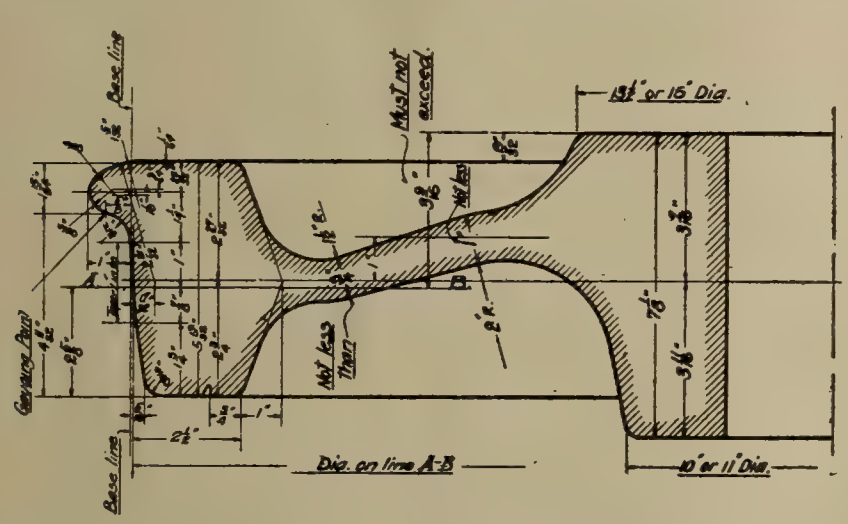


Exhibit C—30, 33 and 36-inch Solid Steel Engine Truck Wheel, 13½" or 15" Diameter Hub.

each wheel. Arrangement of letters shown on Sheet No. —, M. M. Recommended Practice.

V. Finish.

The wheel shall be free from injurious defects and shall have a workmanlike finish.

Wheels shall not be offered for inspection if covered with paint, rust or any other substance to such an extent as to hide defects.

VI. Inspection.

Inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered.

The manufacturer shall afford the inspector, free of cost, all reasonable facilities and necessary gauges to satisfy him that the wheels are being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment, and free of cost to the purchaser.

The purchaser may make the tests to govern the acceptance or rejection of material in his own laboratory or elsewhere, as may be decided by the purchaser. Such tests, however, shall be made at the expense of the purchaser.

All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

Wheels that show injurious defects while being finished by the purchaser shall be rejected, and manufacturer properly notified.

Samples of rejected material must be preserved at the laboratory

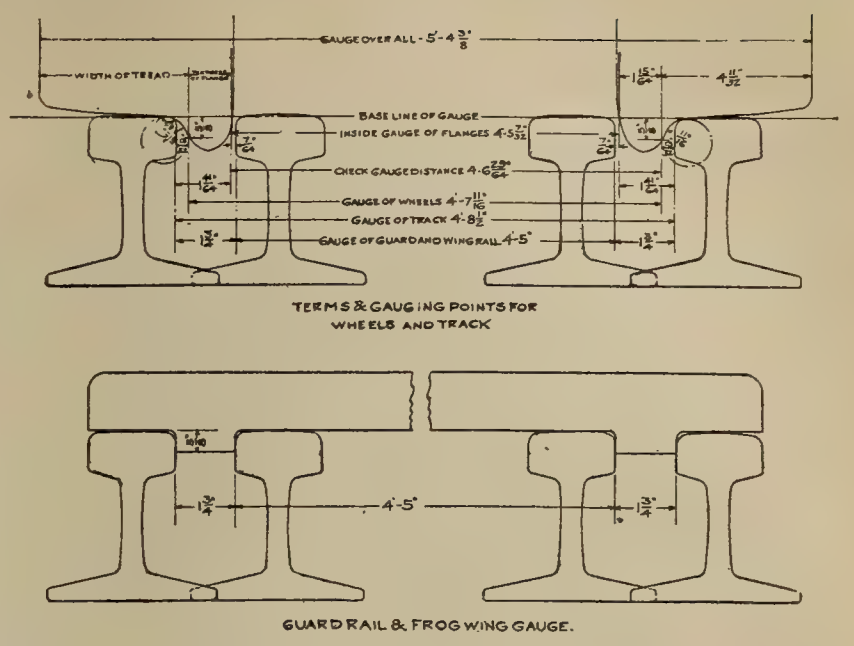

GAUGE OVER ALL - 5'-4 3/8"
WIDTH OF TREAD
BASE LINE OF GAUGE
INSIDE GAUGE OF FLANGES 4'-5 7/32"
CHECK GAUGE DISTANCE 4'-6 25/64"
GAUGE OF WHEELS 4'-7 11/16"
GAUGE OF TRACK 4'-8 1/2"
GAUGE OF GUARD AND WING RAIL 4'-5"
TERMS & GAUGING POINTS FOR WHEELS AND TRACK
4'-5"
GUARD RAIL & FROG WING GAUGE.

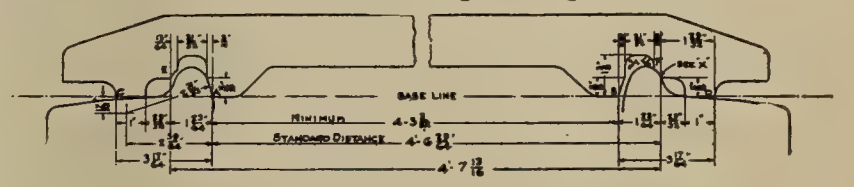
Exhibit Z—Terms and Gauging Points for Wheels and Track.

of the purchaser for one month from date of test report. In case of dissatisfaction with the results of the test, manufacturer may make claim for a rehearing in that time.

It is recommended that the following gauges and cuts be adopted as standard and shown in the Proceedings of the Association, as follows:

RECOMMENDATION No. 2.

Standard design for solid steel wheels for engine and tender truck service to be as shown on the following drawings:



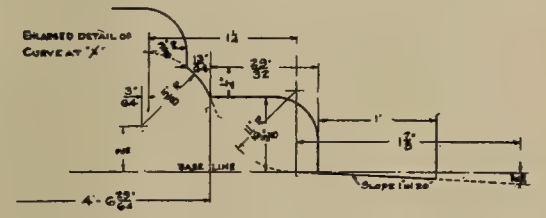


Exhibit X—Wheel Mounting and Check Gauge.

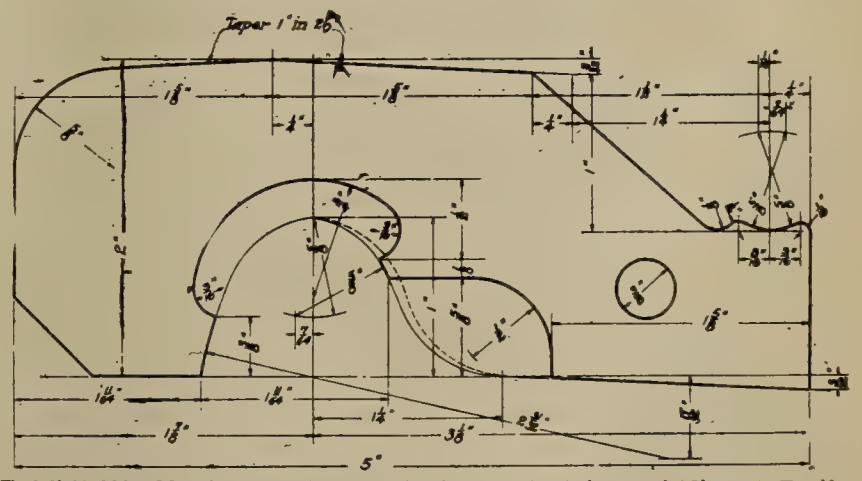


Exhibit W—Maximum Flange Thickness, Height and Throat Radius Gauge for Cast Iron and Solid Steel Wheels.

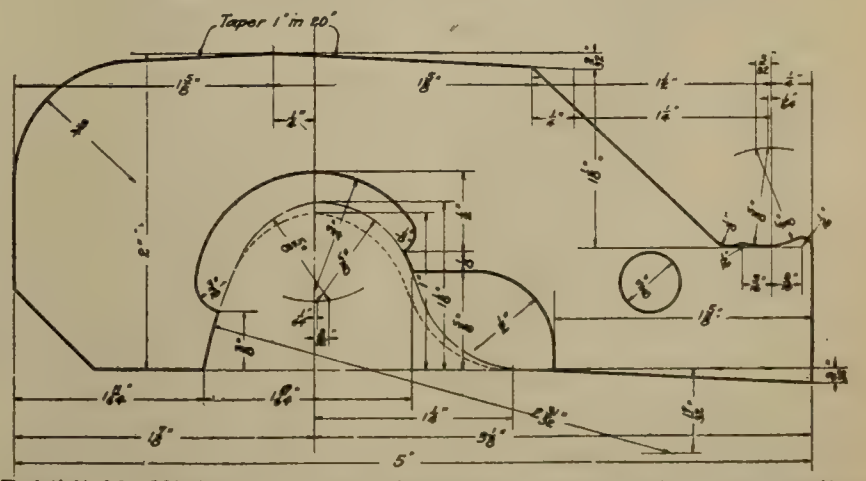


Exhibit V—Minimum Flange Thickness, Height and Throat Radius Gauge for Cast Iron and Solid Steel Wheels.

33-inch solid steel wheel for tenders, 5½-inch axle or under, Exhibit A-1.
36-inch solid steel wheel for tenders, 5½-inch axle or under, Exhibit A-2.
38-inch solid steel wheel for tenders, 5½-inch axle or under, Exhibit A-3.
33-inch solid steel wheel for tenders, 6 by 11 inch axle, Exhibit B-1.
36-inch solid steel wheel for tenders, 6 by 11 inch axle, Exhibit B-2.
38-inch solid steel wheel for tenders, 6 by 11 inch axle, Exhibit B-3.
30-inch solid steel wheel for engine trucks, Exhibit C-1.

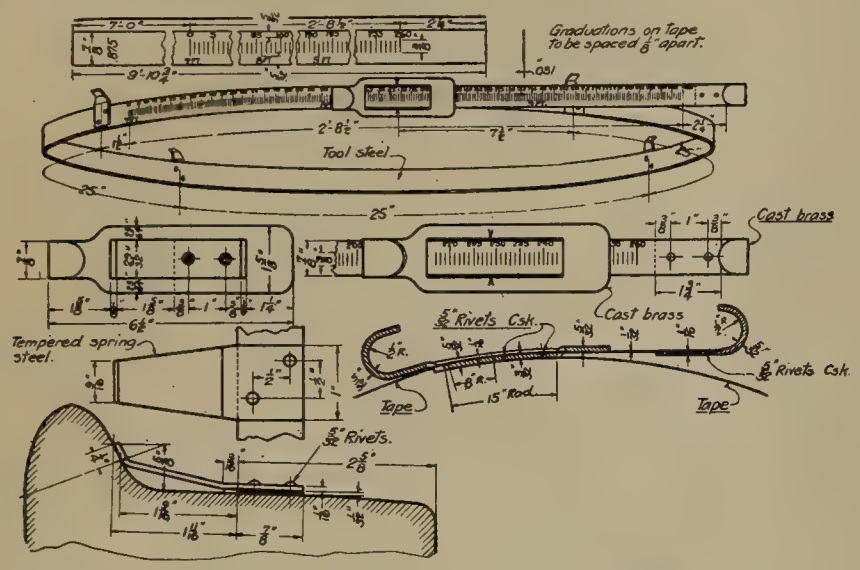


Exhibit T—Circumference Gauge for Steel and Steel Tired Wheels.

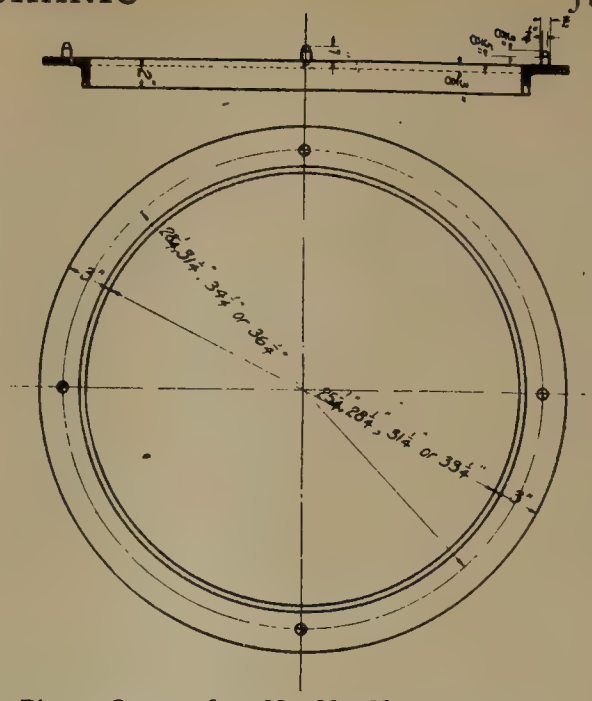


Exhibit R—Plane Gauge for 30, 33, 36 and 38-inch Solid Steel Engine and Tender Truck Wheels.

RECOMMENDATION No. 3.

Terms and gauging points for wheels and track as shown on drawing. Exhibit Z.

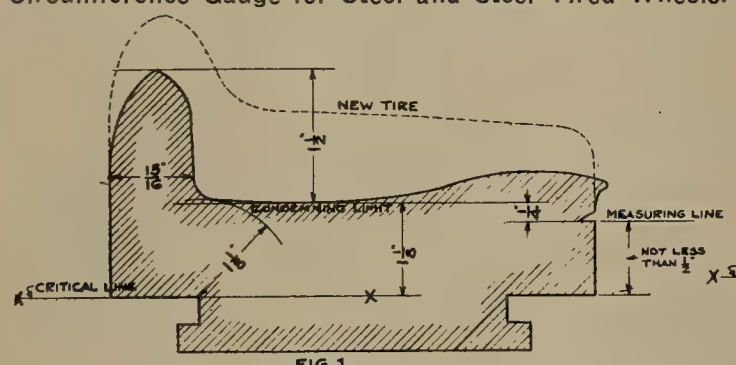


FIG. 1.
STEEL TIRE.
RETAINING RING FASTENING

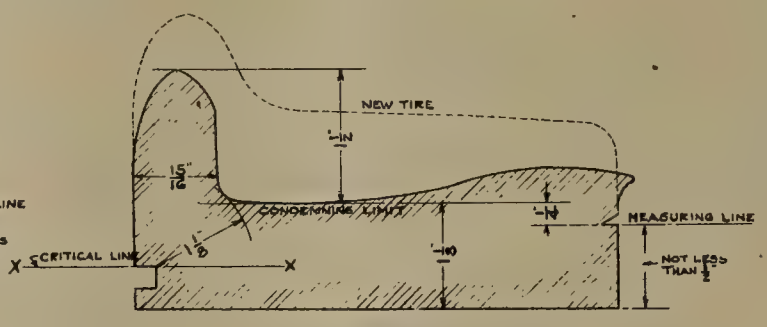


FIG. 3.
STEEL TIRE
RETAINING RING FASTENING.

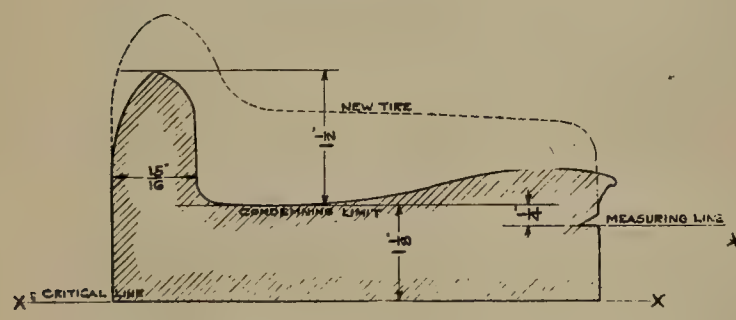


FIG. 2.
STEEL TIRE
SHRINKAGE FASTENING ONLY

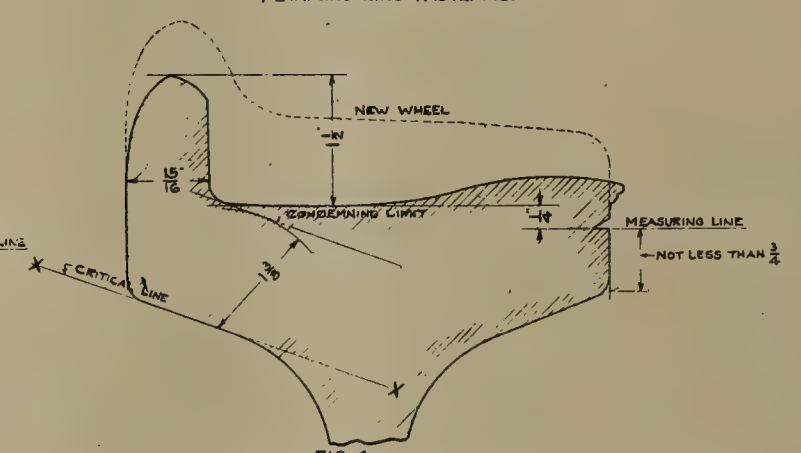


FIG. 4.
STEEL WHEEL

Exhibit S—Limits of Wear for Steel and Steel Tired Wheels.

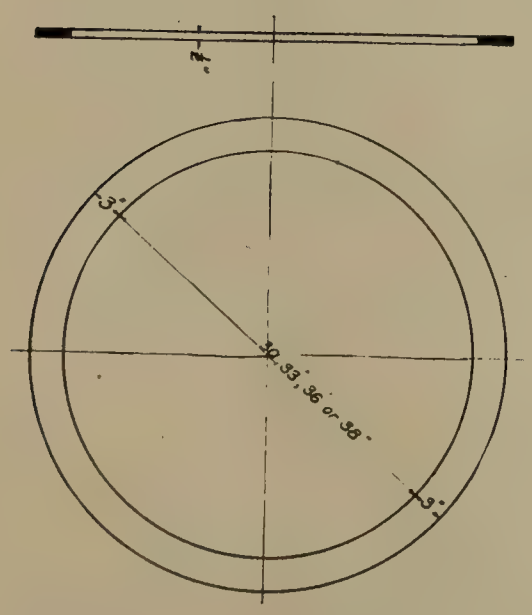


Exhibit Q—Rotundity Gauge for 30, 33, 36 and 38-inch Solid Steel Engine and Tender Truck Wheels.

33-inch solid steel wheel for engine trucks, Exhibit C-2.
36-inch solid steel wheel for engine trucks, Exhibit C-3.

RECOMMENDATION No. 4.

Guard-rail and frog-wing gauge shown on drawing, Exhibit Z.

RECOMMENDATION No. 5.

Wheel mounting and check gauge as shown on drawing, Exhibit X.

RECOMMENDATION No. 6.

Maximum flange thickness, height and throat radius gauge for solid steel, steel-tired and chilled and cast-iron wheels, as shown on drawing. Exhibit W, to be substituted for maximum flange thickness gauge shown on M. M. Sheet No. 14.

RECOMMENDATION No. 7.

Minimum flange thickness, height and throat radius gauge for solid steel, steel-tired and chilled cast-iron wheels shown on drawing, Exhibit V, to be substituted for minimum flange thickness gauge shown on M. M. Sheet No. 14.

RECOMMENDATION No. 8.

Standard wheel circumference measure for cast-iron wheels as shown on M. M. Sheet No. 14, to be changed as shown on drawing.

RECOMMENDATION No. 9.

Standard wheel circumference measure for steel and steel-tired wheels as shown on drawing, Exhibit T.

RECOMMENDATION No. 10.

Cuts giving minimum thickness or limit of wear for steel tires with retaining ring fastenings, shinkage fastening only, retaining ring fastening, solid steel wheels, to be shown as per drawing, Exhibit S.

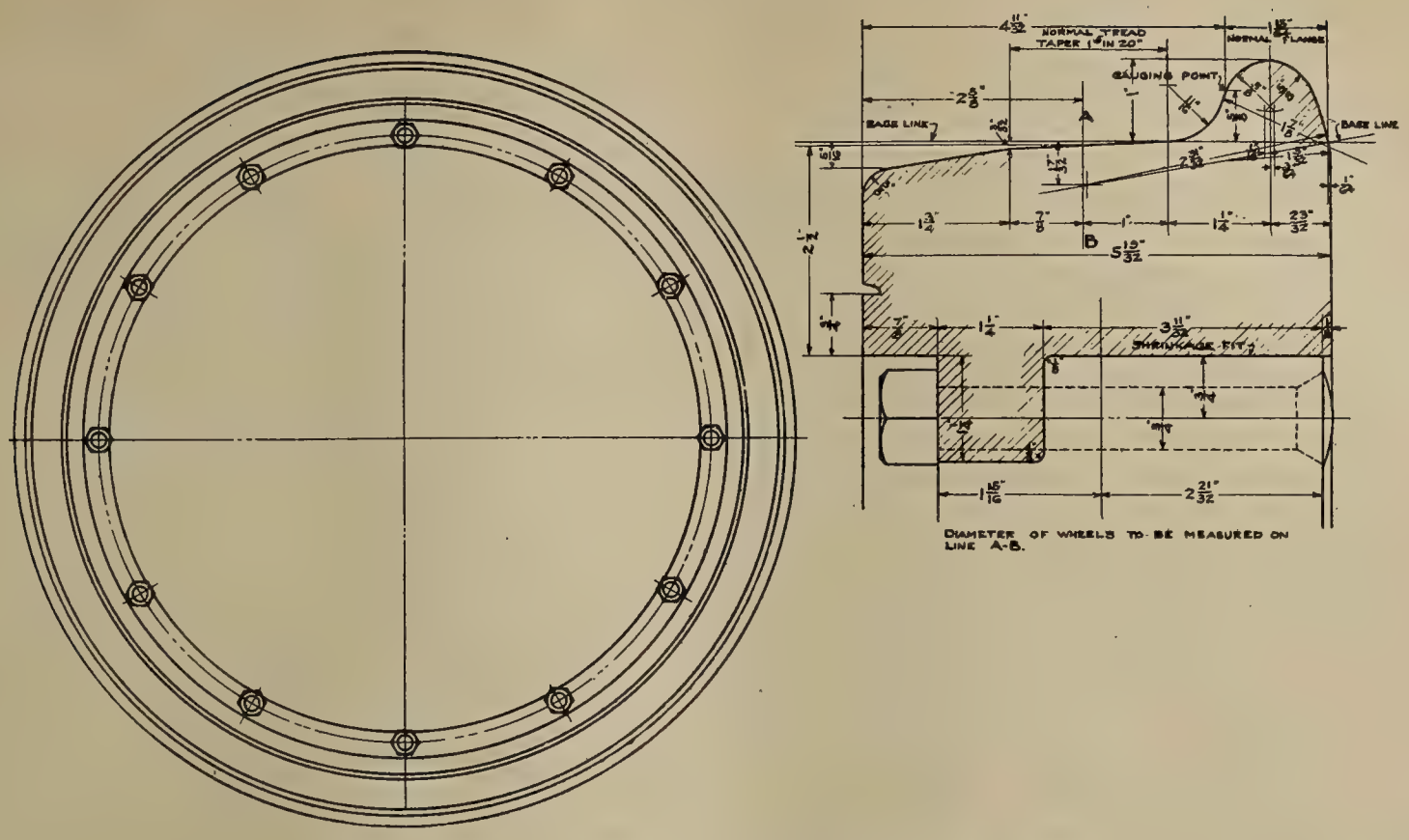


Exhibit L—Proposed Tire Fastenings for Steel Tired Wheels.

RECOMMENDATION No. 11.

Plane gauge for 30-inch, 33-inch, 36-inch and 38-inch solid steel engine and tender truck wheels as shown on drawing, Exhibit R.

RECOMMENDATION No. 12.

Rotundity gauge for 30-inch, 33-inch, 36-inch and 38-inch solid steel engine and tender truck wheels as shown on drawing, Exhibit Q.

RECOMMENDATION No. 13.

Gauge for measuring steel wheels to restore contour as shown on drawing.

RECOMMENDATION No. 14.

Limit gauge for remounting cast-iron wheels and method of using same as M. C. B. Standard Practice, Sheet 16-A.

RECOMMENDATION No. 15.

According to specifications for solid steel wheels, Recommendation No. 1, the method of branding solid steel wheels and size of letters for branding to be as shown on drawing.

RECOMMENDATION No. 16.

It is recommended that the M. C. B. revised and rearranged specification for chilled cast-iron wheels be substituted for the specification of chilled cast-iron wheels for tender service, shown in last Proceedings of the M. M. Association.

RECOMMENDATION No. 17.

Substitute present cuts of 60,000-pound. 80,000-pound and 100,000-pound capacity chilled cast-iron wheels with cuts as shown on drawing.

RECOMMENDATION No. 18.

Adopt standard tire fastening for steel-tired engine and tender truck wheels, same as shown on drawing, Exhibit L.

Committee: W. Garstang (Chairman), W. C. A. Henry, A. E. Manchester, R. L. Ettenger, J. A. Pilcher, O. C. Cromwell.

Discussion.

William Garstang (C., C., C. & St. L.)—Dr. Dudley of the New York Central, speaking with regard to defects in rails, says that due to our present contour the greatest part of the load is carried on the inside of the rail, thus causing fractures. With regard to cast-iron wheels of 140,000 pounds capacity, would say that there are some on exhibition at this convention, and there are quite a number of these wheels now in service. When the wheel is new, the thick flange passes through frogs and crossings without interference, but as it becomes worn ⅛ inch or more there is an interference. This question is now being considered by the Master Car Builders' Association and also by the manufacturers, with the view of taking it up with the American Railway Association. It is purposed to have the frogs and crossings changed from 1¾ to 1⅞ inches.

F. F. Gaines—I move that the recommendations be submitted to letter ballot.

This motion was carried.

ELECTION OF OFFICERS

Previous to the election of officers the report of the committee on correspondence and resolutions was read by H. T. Bentley, and at its conclusion he suggested that for the coming year a report on the subject of "Train Resistance and Tonnage Rating" would be very timely, and also that a committee be appointed to review the work of the various other organizations subsidiary to the Master Mechanics' Association.

The report of the auditing committee was approved and the application of Prof. Woods of Pennsylvania State College for associate membership was received.

A communication from a committee of the Master Blacksmiths' Association, asking that their members be given greater consideration and encouragement in attending conventions, particularly with regard to transportation and loss of time while attending, was read by the secretary.

F. F. Gaines moved that the members do more to urge their blacksmiths to attend conventions of Master Blacksmiths' Association.

This motion was carried.

The election of officers for the coming year resulted as follows: President, D. R. MacBain, L. S. & M. S., Cleveland, Ohio; first vice-president, F. F. Gaines, Central of Georgia, Savannah, Ga.; second vice-president, E. W. Pratt, C. & N.-W., Chicago; third vice-president, William Schlafge, Erie, New York; treasurer, Angus Sinclair.

Executive members for two years were elected. They are: W. J. Tollerton, C., R. I. & P.; J. F. DeVoy, C., M. & St. P.; J. T. Wallis, Pennsylvania. F. H. Clark, B. & O., was elected for one year

S. H. Blewett presented the ex-president's badge to D. F. Crawford.

Report of the Forty-Seventh Annual Convention of the Master Car Builders' Association

The forty-seventh annual convention of the Master Car Builders' Association was held in the Greek Temple, Young's Million Dollar Pier, Atlantic City, N. J., commencing Monday, June 16, 1913. The first session was called to order by President Fuller and the meeting was opened with prayer by the Rev. Cadwell, of Atlantic City. The address of the president followed.

ADDRESS OF PRESIDENT FULLER.

While we have been lending our best efforts to car construction and to the promulgation of rules which have for their purpose the minimizing of restrictions and delays in the interchange of cars, have we as an association always kept before us the necessity for taking into consideration also the question of reducing the cost of maintenance and operation of equipment? This is essential, you will agree, and it is of paramount importance that this association as a whole, and each of its committees, should weigh the cost and consider carefully the benefits attainable by their adoption before approving or advancing any changes, and especially those that will entail large expenditures.

A number of reports will be presented by standing and special committees for your consideration, and it is hoped they will be afforded careful scrutiny and be given a full and impartial discussion. Let us consider carefully all the various recommendations which are placed before us for approval, and let us not lend the prestige of this association to anything that will mean increase in maintenance and operation, which cannot be satisfactorily defended before the bar of public opinion on the grounds of safety and economic progress. While it may be true that we are surrounded by flattering conditions of prosperity, it is nevertheless true that the expenditures which our companies have been called upon to make, by reason of changes in car construction, have in recent years been enormously increased. Our watchword, therefore, should be "Economy."

The committee on Standards and Recommended Practices has given very careful and exacting consideration to the problems submitted to it, and has presented a report which will be found both interesting and instructive.

The committee on car construction has presented an interesting report, with appropriate recommendations to be submitted for the consideration of the members. A salient feature of this report is the determining of a limit for minimum strength of underframes. This limit is based on the minimum cross-sectional area of center sills, and, when approved, will serve as a basis to define the handling line's responsibility for combination of damages under ordinary usage to such cars as fall below the minimum strength so established. I feel that this committee should be continued, and that it should undertake to consider seriously the building of heavier capacity cars—say of 70 tons capacity—so as to increase the tonnage and enable us to reap the benefit of reduced grades and heavier tonnage without increasing the length of our trains.

In freight car construction there has been a decided trend within the last year or so towards single-sheathed box and other house cars, indicating that this type of car is growing in favor. It has the advantage of light weight combined with strength of superstructure, comprising rolled or pressed steel shapes riveted to the underframe, but the problems of the end construction and providing for the shrinkage of lumber in the side and end lining still confront us and must receive our further attention. In view of this it seems questionable whether the solution of the entire proposition is not steel construction for freight car equipment. Speaking of steel construction, in going from wood to steel in passenger car construction probably the most important feature is that of proper insulation, which was largely neglected in the beginning, due principally to a lack of appreciation of the enormous difference between heat conductivity of steel and wood construction. Some types of early steel cars were unsuccessful from a heating standpoint; others have been made comfortable only by the addition of an unusual amount of heating surface, and the question of insulation of steel passenger cars at the present time merits our earnest study.

The coupler committee has made a report which we believe is worthy of your full consideration, and especially should the question of contour lines be considered, to enable flexibility in passing around sharp curves, consequently reducing undue strains on the underframe of the car, as well as reducing the flange friction. I feel that this committee should be encouraged, and that early action should be taken to adopt a standard M. C. B. coupler.

While this association by letter ballot has adopted wheel tolerances for solid steel wheels as recommended practice, under the head of "Specification Covering Dimensions and Tolerances for Solid Wrought-Steel Wheels for Freight and Passenger Car Service," there is a possibility that this specification should go further and show the desired chemical analysis, together with the methods of test and inspection. In this connection I wish to remark that the Master Car Builders' Association is fully qualified from every standpoint to formulate its own standards and specifications, and I would recommend that a committee be appointed for the ensuing year to take this subject under consideration and make a complete report at the next convention.

With reference to the matter of light weight and maximum weight capacity stenciling of freight cars; the railroads have been rather loath to follow out the original recommendation of the association regarding this method of stenciling. The committee has been confronted with the danger that the universal adoption of the plan would possibly transfer the responsibility for failure of cars of weak construction to the handling line. At the same time it feels the necessity for recognizing the right of companies to adopt this method of stenciling for such cars as are of proper design and physical strength, to enable them to increase the carrying capacity of a very considerable number of cars without any untoward results. It is, therefore, recommended for your consideration that this stenciling be confined to steel and steel underframe cars with a proper factor of safety in the body structure and trucks.

In the last few years the abuse of the repair card has had considerable attention at the hands of the association, and the executive committee has given this subject consideration during the past year. It is recognized that honesty cannot be legislated into the human race; however, it is believed that if the officials of the various companies will give it out plainly to their subordinates that sharp practices will not be tolerated, the complaint that some companies are making "pencil repairs" to cars will be done away with.

During the past year the American Railway Association through its committee on car efficiency reported to the executive committee a serious condition at several large interchange points, brought about by the enforcement of that part of M. C. B. Rule No. 2, which requires that defect cards must be attached to cars at the time of interchange. The delays incident to the enforcement of this rule became unbearable to some companies. Cars were set back for defect cards by both sides, and the situation became critical at some locations. It was up to the executive committee to act. It was clearly not possible to rescind that part of the rule requiring that defect cards be placed on cars. The executive committee, after due deliberation, agreed that it was absolutely necessary to reduce the number of defect cards issued. It was the opinion that this could be brought about by making some provision or arrangement, whereby the necessary repairs would be made to the cars by the handling line, so that defect cards would not be required by the receiving line; and by eliminating the carding of owner's defects. Defect cards were being issued for defects which, although primarily "owner's responsibility" became "handling line's responsibility" as soon as the car crossed an imaginary line at the time of the interchange. The committee felt that there could be no possible objection raised, nor any injustice done any car owners, by placing the responsibility where it primarily belonged. Again it was a well-known fact that the prices allowed in the rules for both labor and material were not increased in recent years to meet the advances in wage schedules and the increases in cost of materials, nor did the prices in the car interchange rules include any percentage to cover facilities, supervision, or use of tools. To meet the emergency that existed the executive committee, by virtue of the authority given it by the constitution, caused circular No. 8, "Result of Special Letter Ballot on Change in the Rules of Interchange" to be issued by the arbitration committee, effective November 1, 1912, by which the existing condition was almost immediately relieved. We have reliable information from several large interchange points indicating that the number of defect cards has been reduced approximately one-half.

It is a well-known fact that the executive committee, through the arbitration committee, is called upon at times to interpret certain parts of the Interchange Rules, also to meet emergencies and to remove misunderstandings that are shown to actually exist to the detriment of prompt interchange of cars, and it has been necessary to instruct the arbitration committee to issue certain circulars to the members to meet such emergencies. Should there be any doubt in the minds of the members as to whether the reading of article six of the constitution invests the executive committee with authority to so instruct the arbitration committee, I would suggest that a committee be appointed to revise this article and remove the uncertainty.

The past year has been a particularly strenuous one for the members of the arbitration committee; their duties have been arduous and they have had some hard problems to face. I feel they are entitled to much credit and that the Association is greatly indebted to them for the work they have accomplished. I believe we can do much to lighten the labors of this committee. It has had to contend, especially in the last year or so, with cases which were based on the most trivial and technical objections; also in some instances with matters of a nature that should be settled by the contestants themselves, instead of placing the burden on the committee. It is, therefore, hoped that railroads and private car companies will refrain from placing themselves in a position where it would seem they are trying to evade payment of bills on technicalities. Another thing which I might mention under this heading is the method practiced by some roads of delaying pay-

ment of bills on technical objections. To remedy this trouble the arbitration committee will submit for your consideration a revision of interchange rule No. 91 which we hope will meet with your approval.

The subject of "Salt Water Drippings from Refrigerator Cars" has been discussed for a great many years; we now have a recommended practice. At the present time the damage to track and bridges due to the dripping of brine from refrigerator cars warrants advancing this to standard, and the arbitration committee in its report this year has recommended a time after which no car carrying products which require for their refrigeration the use of ice and salt, will be accepted in interchange unless equipped with suitable devices for retaining the brine between icing stations. This subject is of such importance to the railroads that it is hoped the arbitration committee's recommendation will be adopted by the association and incorporated in the interchange rules.

There is another subject that has been receiving considerable attention of late, particularly by western roads—the retirement of cars of 50,000 pounds and less, capacity. A great number of these cars are equipped with old style triple valves, and their physical condition as a rule is not such as to make them desirable equipment to be handled in heavy trains over steep grades. This subject will come up at the noonday discussion of topical subjects, and it is to be hoped that this matter will be fully discussed with a view to having each road confine its light equipment to local business.

The necessity of putting car roofs in proper condition is another matter, which I believe should have the attention of the association with a view to taking action that will overcome the trouble being experienced by the roads and the expense incidental to claims being paid on accounts of leaky roofs.

At these annual gatherings, in addition to the opportunity for exchange of ideas and absorption of knowledge, we are afforded further mental treat through the elaborate and up-to-date display of modern railroad machinery and tools which the manufacturers place before us, and I feel they are entitled to our thanks and appreciation. I would urge the members to take full advantage of the opportunity.

REPORTS OF THE SECRETARY AND TREASURER.

The report of Secretary Taylor showed the present membership to be 879, classified as follows: Active, 433; representative, 414; associate, 11; life, 21. The number of cars represented the association in June, 1913, was 2,713,656, as compared with 2,593,397 in 1912. The report of the treasurer showed a balance in treasury of $627.91, this being the same balance as reported in 1912. The secretary reported that the following changes in the constitution had been submitted to the members:

Section 1, Paragraph 2—A new paragraph added to read as follows:

"The executive committee may exercise such supervision over the standards, recommended practice or rules of this association as may be necessary to meet any emergency that may arise during the year in the conduct of the affairs of the association, such action to be taken only on the unanimous vote of the members of the executive committee."

Third paragraph, revised: "It shall make a report at each convention, which shall cover the action it has taken on such general or emergent supervision and make such recommendations as it may deem necessary on questions of importance to the association."

F. W. Brazier (N. Y. C. & H. R.)—I move that the proposed amendment be approved. This motion was carried.

The reports of the secretary and treasurer were referred to the following auditing committee: T. M. Ramsdell, T. J. Burns and E. W. Pratt. The executive committee recommended that the dues be increased to $5.00.

J. J. Hennessey (C., M. & St. Ry.)—I move that the dues be made $5.00, as recommended by the executive committee. This motion was carried.

The following were appointed the committee on correspondence and resolutions: T. M. Ramsdell, R. D. Smith and T. H. Goodnow.

REVISION OF STANDARDS AND RECOMMENDED PRACTICE.

After due consideration of present Standards and Recommended Practice of the Association, together with replies from members to the circular of inquiry, and in connection with which we wish to say that very few of same were received; also requests involving standards presented by the secretary, the committee desires to report as follows:

Journal Box and Details.
(Standard.)

Page 678. For journal 5 by 9 inches. Sheets M. C. B. 7, 8, and 9.
Page 679. For journal 5½ by 10 inches. Sheets M. C. B. 10, 11 and 12.

A member calls attention to the fact that lid for 80,000 and 100,000 pound box does not close tight on the face of the box, if dimensions are closely adhered to for the hole in the lug and the hole in the lid, and suggests that it would be desirable to change the location of the hole in the lid from 9/32 inch, as at present, to $\frac{5}{16}$ inch. Your committee concurs in this recommendation.

Axle "A."
(Standard.)

With journals 3¾ by 7 inches. Page 681. Sheet M. C. B. 15.

A member calls attention to investigation of a number of axle failures which have caused derailment on their system, and in which it has been found that they were almost entirely caused by 3¾-inch journals, worn close to the M. C. B. condemning limits. This, of course, referring only to journals with "cold breaks," as contrasted with journals "burned off." No failures were recorded of "cold breaks" in the 5 by 9 and 5½ by 10 sizes. Except as a result of derailment, these were all journal failures, and to overcome this trouble as far as possible, special instructions have been put into force, and the condemning limits of the 3¾-inch axles considerably raised.

From the foregoing it is safe to assume that the M. C. B. condemning limits for the 3¾ by 7 inch journals do not provide for the same margin of safety as in the larger sizes, due probably in part to the very heavy mileage that the small journal makes before reaching its condemning limits contrasted by the fact that in the case of the 5½ by 10 and to a lesser degree the 5 by 9 journals, are generally condemned by collar wear or journal length before they reach the minimum diameter.

"If this is correct, which I believe investigation on other lines will prove, the M. C. B. Association should increase the condemning limit for the 3¾ by 7 inch journals to give a greater margin of safety which I believe is required particularly in winter weather in the northern climates, into which district any of the cars of the southern lines are apt to pass."

The committee does not concur in this recommendation.

Axles "C" and "D."
(Standard.)

With journals 5 by 9 inches and 5½ by 10 inches. Sheet M. C. B. 15.

A member calls attention as follows:

"There are quite a number of cases of cars of relatively heavy tare weight using 5 by 9 and in some cases 5½ by 10 journals. From information we have received, I believe particularly in the case of the 5½ by 10, that the journals seldom reach their condemning limits unless frequently in the 5 by 9. As cold breaks in these sizes are practically unknown even in our cold climate with frozen track and road bed, if it can be shown that the larger condemning limit for journal diameter could be put into force without shortening the present life of these axles and that their freedom from failures even under overload has shown them to have a very considerable margin of safety, is there any reason why the permissible load carried might not be slightly increased—I believe less than 5 per cent increase would be sufficient—to enable some existing equipment to carry 10 per cent overload, which is becoming generally customary, without an overload on the journal, particularly as the tendency is to increase the weight of the underframe to meet service conditions which makes it difficult to build stiff cars to carry their nominal capacity with 10 per cent overload and not overrun the journal capacity. The point I would particularly wish to make is that the relative percentage of failures shows that the margin of safety in the various axles due to various causes is not the same, and I am merely offering these suggestions for your consideration."

The committee does not concur in this recommendation.

Axles.
(Standard.)

Pages 681 to 684. Sheets M. C. B. 15 and "B."

Through a member, the following communication from Mr. George R. Henderson, consulting engineer of the Baldwin Locomotive Works, was received:

"I desire to call your attention to some investigations which I have recently made regarding the standard M. M. and M. C. B. axles in connection with the operations of the quick action ET brake under emergency application.

"There have been cases of axle failures under tenders and also there have been cases where there seems to be a tendency of the journal to roll out of the bearing or under the edge of the bearing when a severe application of the brake is made.

"Referring to the question of the strength of the axle, would say that I have investigated the combined action of the brake taken in connection with the worst strains that can occur from the natural loading and wind or centrifugal pressure, which horizontal force has been assumed at 40 per cent, or just sufficient to relieve the rail on the windward side of pressure and throw the whole load on the outer or leeward side rail. Of course this is the worst case that could occur, as any further horizontal strains would cause the car to roll entirely off the track. I find that under these conditions the greatest strains occur at the point just inside of the collar at the inner point of the wheel hub and that this strain amounts to from 22,500 to 23,000 pounds on the 5 by 9 and 5½ by 10 axles. Of course, I see the logic of making the weakest point at this section where a crack could be discovered, which would not be the case if it occurred the other side of the collar next to the wheel hub; however, the stress seems rather high, but the action of the brake shoe coming at right angles to these stresses does not materially affect the outer strains in the axle.

"It is possible with an emergency application of the ET brake, when the brake-shoe pressure is based on 80 per cent of the light weight of the tender with fifty pounds of air in the cylinder, in accordance with the recommendations of the Westinghouse Air Brake Company, to obtain a shoe pressure equal to about one-third of the normal axle

load or maximum load for which the axle is intended. Thus, for the 5 by 9 axle the pressure horizontally of each brake shoe may amount to 10,000 pounds under the conditions above stated and, if the tank should be practically empty, there would be very nearly enough side pressure, taken in connection with the journal friction, to roll the axle out of the bearing. In other words, for the 5 by 9 axle there is a moment of 26,700 pounds disturbing force against a static moment of 30,000 pounds tending to maintain it in the bearing, and the 5½ by 10 axle gives a disturbing moment of 36,700 pounds as opposed to 40,000 pounds of stability.

"The subject of axles rolling out of the bearings has been considered by the Westinghouse Air Brake Company, and I was recently told by Mr. Turner, the chief engineer of that company, that they were recommending double or clamp brakes on passenger equipment to take care of this trouble. This would be almost prohibitive on freight cars and tenders equipped with freight trucks, and it is possible that for these conditions it would be desirable to alter the depth of the standard bearing in order to reduce this tendency of the axle to roll out of the bearing."

The committee refers this to the committee on car trucks.

Axle "E."

(Recommended Practice.)

Page 683. Sheet M. C. B. "B."

A member suggests advancing axle with 6 by 11 journal, designed to carry 50,000 pounds, to standard.

The committee concurs in this recommendation.

Specifications for Steel Axles.

(Recommended Practice.)

Pages 685 to 688.

The committee received through the secretary communication from Jones & Laughlin Steel Company, raising the question as to rejection limits of steel axles, with respect to silicon and sulphur, which are not mentioned, although included in the desired analysis.

The committee believes that this should be included in the rejection limits, and recommends the appointing of a committee to revise axle specifications in general.

Arch Bars.

(Standard.)

Pages 782-783. Sheet M. C. B. 20.

A member calls attention to the absence of specification for iron or steel arch bars, and suggests that specifications be drawn up for same.

The committee concurs and recommends the appointing of a special committee for this purpose, and includes in this recommendation all bar iron or steel used in car construction.

Signal Lamp Socket.

(Standard.)

Page 802. Sheet M. C. B. 26.

In accordance with action of this Association, 1912 convention, with respect to location of signal lamp socket in relation to exposure of marker lamp.

The committee, after further consideration of the matter, recommends this as indicated in sketch accompanying, which is at a fixed angle of 45 degrees, and, as well, at a specified distance from the side of car to the center of socket.

Marking on Freight Equipment Cars.

(Recommended Practice.)

Page 804. Sheet M. C. B. "G."

A member suggests that this be advanced to standard, and sheet M. C. B. "G." corrected as to location for marking United States Safety Appliances Standard.

The committee concurs in this recommendation.

Markings on Freight Equipment Cars.

(Recommended Practice.)

Page 805. Sheet M. C. B. "G."

The attention of your committee was called to American Railway Association Car Service Rule No. 11, as revised November 20, 1912, which has reference to the weighing of freight equipment, and omits the star indication, with recommendation that the Recommended Practice of this Association be changed to conform.

The committee concurs in this recommendation.

Marking on Freight Equipment Cars.

(Recommended Practice.)

Pages 804-805. Sheet M. C. B. "G."

Through the secretary of the Association was referred the suggestion of a representative of the American Railway Association for a standard for stenciling on cars of date of building, on account of the requirements in regard to the reweighing of cars.

The committee concurs in this recommendation, and suggests that the word "new" be stenciled preceding the word "weight," in accordance with the American Railway Association Car Service Rule No. 11, as amended November 20, 1912.

Springs and Spring Caps for Freight Car Trucks.

(Recommended Practice.)

Page 903. Sheet M. C. B. "H."

A member suggests adding a spring for the 140,000-capacity freight car truck.

The committee concurs with the recommendation, and refers same to the committee on Car Trucks.

Classification of Cars.

(Recommended Practice.)

Pages 906-913.

Through the secretary, request from Mr. G. P. Conard, secretary of the Association of Transportation and Car Accounting Officers, for assignment of designating symbols for equipment, was received, as follows:

"BM"—Milk Car.—Exclusively for the transportation of milk, being a car for this purpose and fully equipped for handling in passenger trains.

"ES"—Electric Passenger Car.—For long hauls or suburban service; multiple unit, and fitted with automatic couplings and air brakes. Operating power, storage battery.

"GB"—Gondola Car.—A car with solid bottom, sides and ends, and open on top; suitable for mill trade.

Note to Follow Class "H."

If any of these hopper cars are provided with roof or cover for protection of contents, the letter "R" should be affixed to the regular symbol to designate its special class of service.

"MBE"—Combination, Baggage, Mail and Express Car.—A car having three compartments, each entirely separate from the other for handling its individual class of business.

"MPB"—Combination, Baggage, Mail and Express Car.—A car having an individual compartment, each entirely separate, one suitable for mail, one suitable for baggage and one suitable for passengers.

"XI"—Box Car, Insulated.—A box car having walls, floor and roof insulated, not equipped with ice bunkers or baskets. This car ordinarily used for transporting vegetables, freight, etc.

"MWX"—Boarding Outfit Cars.—This includes cars used for boarding, sleeping, or cooking purposes in construction and similar work.

The committee concurs and assigns symbols as indicated.

A member suggests assigning designating symbols to the following class of equipment:

"MWE"—Ballast Speader and Trimmer.—A car with blades or wings for spreading or trimming ballast.

"MWJ"—Ballast Unloader.—A car equipped with machinery for pulling a plow through cars loaded with ballast.

"MWP"—Pile Driver.—A car equipped with machinery for pile-driving.

"MWK"—Snow Removing Cars.—Cars equipped with any special device for removing snow from between or along side of rails.

"MWM"—Store Supply Car.—A car equipped for handling material to be distributed for railway use.

Following the heading of "General Service Freight Equipment Cars," note to be added, as follows:

Any of the following classes of equipment having special heating appliances for the protection of commodity against freezing, to be covered by affixing the letter "H" to the designating symbol.

"SH"—Horse Car.—A car specially fitted for the transportation of horses in freight service.

Weed Burner.—A car equipped with machinery for propelling itself, or otherwise, and burning weeds along the tracks as it proceeds.

Ditching Car.—A car equipped with machinery for propelling itself, or otherwise, and excavating ditches along the sides of the tracks as it proceeds.

Rail Saw.—A car equipped with machinery for sawing track rails and similar material.

Rail Bender.—A car equipped with machinery for bending track rails and similar material.

Grass Cutter.—A car equipped with machinery for propelling itself, or otherwise, and cutting grass along the tracks as it proceeds.

Track Layer.—A car equipped with machinery for propelling itself, or otherwise, and laying the track ahead of itself as it proceeds.

The committee concurs in the recommendation, so far as designating symbols are assigned.

NEW SUBJECTS.

In accordance with action of this Association, 1912 convention, with respect to the establishment of a maximum standard or limiting height for the running board of a standard dimension box car, and which was included in the report of this committee last year, in accordance with your instructions, we have further investigated the subject at hand, and, in view of the variance found, brought about to meet traffic requirements, we do not feel warranted in recommending a standard height for running board in view of the other conditions which enter in connection with this, and, therefore, respectfully submit no further action to the convention this year.

A member suggests the necessity for a journal box, brass and wedge for axle with 6 by 11 journals, so as to complete the Association's approval of the use of an axle with 6 by 11 journal in freight service.

The committee concurs and refers this to the committee on Freight Car Trucks.

A member suggests a standard end for hopper door operating shafts so as to permit the use of standard wrench.

The committee concurs in this recommedation, and favors a 2-inch square end for this purpose.

A member calls attention to difficulty experienced with cars with arch bar trucks, or trucks with rigid side frames, and having side bearings located outside gauge of track, and suggests establishing a standard spacing for side bearings.

The committee concurs in this recommendation, with the suggestion that the maximum side bearing spacing should not exceed the rail gauge, with a minimum of 44-inch centers, and a minimum clearance between side bearings of $\frac{3}{16}$ inch.

A member calls attention to the necessity of end doors on account of the difficulty experienced in having yard clerks obtain seal records of same, due to the inconvenient location and risk of personal injury. Claims are now being paid on account of no end door seal record, and cars are being pilfered by theft through the end doors, which can be entered with the least chance for detection. Is an end door in a standard box car essential? If so, could it not be placed near the side of car where seals could be read from the side ladder?

The committee refers this to the committee on Car Construction.

The committee, at this time, wishes to submit for consideration, separating the proceedings of the Association as at present published, taking out the Standards and Recommended Practice, and have same published as a separate volume.

Committee: T. H. GOODNOW (Chairman), C. E. FULLER, W. H. V. ROSING, W. E. DUNHAM, O. C. CROMWELL, T. M. RAMSDELL, O. J. PARKS.

Discussion.

D. F. Crawford (Pennsylvania)—With regard to the lettering of cars as referred to in the committee report, would say that on account of the numerous markings we have had to put on cars, a badge plate has been suggested. We have a number of steel frame cars with inside sheathing which makes it difficult to put on all the markings required. I would like to know what objection there is to putting on a badge plate. The government is interested in the marking "United States Safety Appliance Standard," and they allow the use of the badge plate. They are not so interested in the other markings on cars, and many cars are at present in service with the badge plate.

M. K. Barnum—It seems to me it would be advisable to request the committee to consider two classes of markings, the first to go on the badge plate and the second to be stenciled. I make that as a motion.

C. A. Schroyer (C. & N.-W.)—Why is it necessary to incorporate this in the recommended practices of the association when it is now permissible.

M. K. Barnum—I believe it necessary in order to have uniform practice.

C. A. Schroyer—There would be no uniform way if the matter is left permissible, for "may be" does not make it a uniform practice. I make an amendment that the portion of the committee's report referring to this matter be stricken out allowing the standards to remain as they now stand.

Mr. Barnum's motion was voted upon and lost.

C. A. Schroyer—I make my amendment as an original motion.

W. F. Kiesel (Penn.)—I make an amendment to that motion that the committee be requested to draw up plans for badge plate.

E. W. Pratt (C. & N.-W.)—I make an amendment to the amendment that the suggestion be referred to the executive committee.

C. A. Schroyer accepted the amendment and the amendment was carried.

TRAIN BRAKE AND SIGNAL EQUIPMENT.

The following subjects have been brought to the attention of the committee for investigation and report:

1. Proper Weights of Freight Cars to Take 10-inch Brake Cylinders.
2. Adoption of K-1 and K-2 Triple Valves as Standard for all Freight Equipment.
3. Proper Size of Brake Pipe to Use on Passenger Car Equipment.
4. Swinging Clamps for Ends of Brake and Signal Pipes on Passenger Cars.
5. Galvanized Brake Pipe and Fittings for Refrigerator and Coal Cars.
6. Standard Brake Pipe Socket or Nipple.
7. Position of Hose Clamp Bolting Lugs on Mounted Hose.
8. The M. C. B. Standard Hose Label.

The committee carefully considered the advantages to be derived from the application to freight cars of brake cylinders of proper size, and recommends that hereafter all freight cars weighing between 37,000 and 58,000 pounds be equipped with 10-inch brake cylinders. The committee also believes that the braking power for freight equipment should be made 60 per cent of the light weight of the car, based on fifty pounds per square inch cylinder pressure. With 10-inch brake cylinders applied to cars coming under the weight limits given, and using the braking power recommended, a total leverage ratio of 9 to 1 need never be exceeded.

The committee has corresponded with the air brake companies for the purpose of ascertaining what triple they would recommend for freight service to be considered as standard. The replies received stated that they would suggest K-1 for 8-inch and K-2 for 10-inch equipments as the one to choose for a standard. The advantage to be derived from the adoption of a standard triple valve for all freight equipment and the elimination from service of several different types

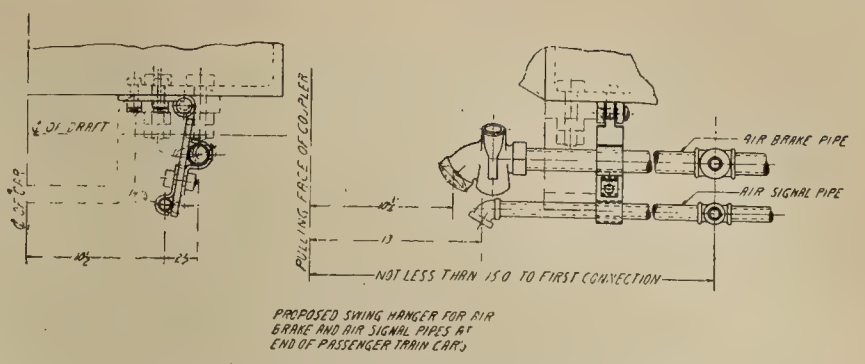

AIR BRAKE PIPE
AIR SIGNAL PIPE
PULLING FACE OF COUPLER
NOT LESS THAN 15'0 TO FIRST CONNECTION
PROPOSED SWING HANGER FOR AIR BRAKE AND AIR SIGNAL PIPES AT END OF PASSENGER TRAIN CARS

Fig. 1—Brake and Signal Pipe Hanger.

are so obvious that the committee does not hesitate to recommend that the K-1 and K-2 triples be made the standard for freight cars.

On account of the increased weight and length of passenger trains, the highest degree of perfection in the operation to obtain uniform application and to avoid annoyance from sticking brakes in releasing is more necessary now than ever before. The internal diameter of the brake pipe plays a very important part in the satisfactory operation of the brake, and therefore your committee gave this matter careful consideration, having before it a report of the results of tests made by the Westinghouse Air Brake Company to determine the effect on brake operation of various internal diameters of brake pipe. This report clearly shows that no pipe having an internal diameter less than that of 1-inch standard weight pipe should be used on passenger cars. It also shows that the larger internal diameter of the 1¼-inch extra-heavy pipe had some important advantages over the internal diameter of the 1-inch standard weight pipe, especially with respect to satisfactory release of brakes at the rear. The committee therefore recommends that no pipe having an internal diameter less than that of 1-inch standard weight be used on passenger cars, and that for all new equipment 1¼-inch extra heavy pipe be used.

In the case of modern passenger cars, the committee believes that the ends of the brake pipe should be supported by swinging clamps and hangers, so that no trouble from hose parting while train is passing through crossovers will be experienced. Fig. 1 illustrates a swinging brake and signal pipe end hanger that has been in service for over two years and has proved efficient in the prevention of hose parting while train is passing through crossovers and around sharp curves.

The action of acids and salt water drippings from coal and refrigerator cars falling onto the brake pipe and its fittings causes them to deteriorate rapidly, and it has been suggested to this committee that the brake pipe on such cars should be galvanized to protect them. While the committee has no definite data on the amount of damage caused by the action of acids on the exterior of the pipe, yet it is known to be large, and it has been discussed at previous conventions. To galvanize the pipe does not add materially to its cost, while it serves to protect it from corrosion. It would, therefore, be a paying proposition to galvanize all brake pipe and fittings, and the practice of doing this is recommended.

There appears to be a lack of uniformity upon the various railroads in the use of a standard socket or pipe coupling, located 10 inches back of the angle cock in the brake pipe. These sleeves or sockets are furnished in various weights and lengths by different manufacturers, and where short ones are used there is more likelihood of leakage. On this account it has been suggested that a standard brake pipe coupling be shown on M. C. B. Sheet No. 18 sufficiently long and heavy to eliminate this objection. The committee has looked into the matter and would recommend that Sheet No. 18, showing location of brake pipe, be revised or amplified so as to show a pipe nipple, extra strong, 11½ inches in total length, and a line pipe coupling, extra heavy, 2⅞ inches long, the distance between the angle cock and pipe coupling to remain the same as at present—10 inches.

The committee's attention has been called to M. C. B. Sheet "Q," showing the position of bolting lugs of hose clamps. If these clamps

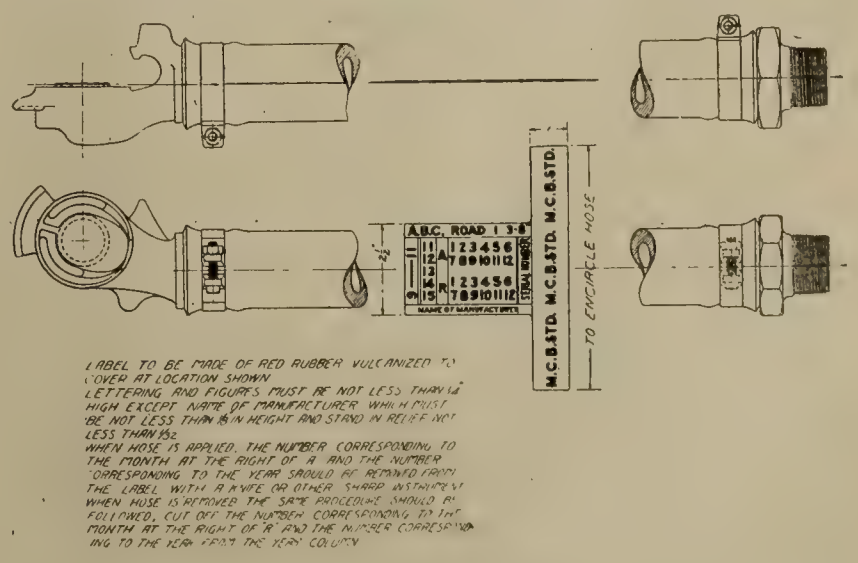

M.C.B.STD.
M.C.B.STD.
M.C.B.STD.
TO COUPLER HOSE
LABEL TO BE MADE OF RED RUBBER VULCANIZED TO COVER AT LOCATION SHOWN
LETTERING AND FIGURES MUST BE NOT LESS THAN ¼" HIGH EXCEPT NAME OF MANUFACTURER WHICH MUST BE NOT LESS THAN ⅛ IN HEIGHT AND STAND IN RELIEF NOT LESS THAN 1/32
WHEN HOSE IS APPLIED, THE NUMBER CORRESPONDING TO THE MONTH AT THE RIGHT OF A AND THE NUMBER CORRESPONDING TO THE YEAR SHOULD BE PUNCHED FROM THE LABEL WITH A KNIFE OR OTHER SHARP INSTRUMENT WHEN HOSE IS REMOVED THE SAME PROCEDURE SHOULD BE FOLLOWED, CUT OFF THE NUMBER CORRESPONDING TO THE MONTH AT THE RIGHT OF 'R' AND THE NUMBER CORRESPONDING TO THE YEAR FROM THE YEAR COUNTER

Fig. 2—Hose Label.

are applied with the lugs in the position shown on the nipple end, they interfere with the operator's hand when operating the angle cock, and at the coupling end will interfere with the steam hose where cars are equipped with both the air and the steam lines. In Fig. 2 is shown the locations of the clamps as the committee believes they should be. In these positions the bolting lugs will be thrown at the nipple end toward the car coupler, thus avoiding interference with the operator's hand in turning the angle cock; and at the hose coupling end they will be out of the way so as to prevent chafing anything from above or below the same. The committee believes an M. C. B. specification, providing for the proper application of the clamps to the hose, should be prepared and the drawings on Sheet "Q" be changed to conform to it.

On account of not carrying out the recommendation made by the committee last year for the adoption of a distinctive hose label, the rearrangement shown on Sheet "Q" costs more to apply, and, therefore, we believe that the design of hose label shown on Fig. 2 is preferable, and we recommend, therefore, that this design be considered for adoption.

A number of subjects were referred to this committee by the committee on hose specifications, but they came too late to deal with them in as thorough a manner as their importance deserves, hence they are held over for another year. There are also many other important brake matters that should be investigated and reported upon.

The members of the Association are earnestly requested to submit to the committee at as early a date as possible matters such as they consider deserving of attention that pertain to the work of the Train Brake and Signal Committee, so that ample time may be had to deal thoroughly with them.

Committee: R. B. KENDIG (Chairman), R. K. READING, B. P. FLORY, E. W. PRATT, L. P. STREETER.

Discussion.

W. E. Dunham (C. & N.-W.)—I do not understand why the committee has recommended extra heavy pipe under item No. 3.

C. D. Young (Penn.)—I would like to ask the committee if in submitting this to letter ballot it would then become a standard of the Association? If such was the case it would seem as if a great many triple valves would have to be removed.

C. A. Schroyer (C. & N.-W.)—We have a great many freight cars now equipped with an 8-inch cylinder, and this recommendation would knock the whole thing out. It seems to me we should be very careful about this.

E W. Pratt (C. & N.-W.)—The air brake companies have had these in use as recommended appliances for several years and most of the up-to-date railroads have been adopting these recommendations.

C. D. Young—We are one of the roads using a 10-inch cylinder and the K-2 triple valves. This, however, would apply to all cars with 8-inch cylinders and plain triple valves, and, therefore, K-2 triple valves would have to be substituted. I move that this matter be made recommended practice for cars built after January 1, 1914.

This motion was carried.

O. C. Cromwell (B. & O.)—I notice in the report that the length of the nipple has been changed from 10 inches to 11½ inches. Why should this be changed?

E. W. Pratt (C. & N.-W.)—The M. C. B. cut shows from shoulder to shoulder and refers to the length of the nipple including threads.

O. C. Cromwell—It specifies the 10-inch nipple which shows no points between which the length is measured.

W. E. Dunham (C. & N.-W.)—I move that the cut be corrected to show a 10-inch nipple; that is, a nipple 10 inches in length.

This motion was carried.

M. K. Barnum—I move that the report with the exception of paragraph 8 be adopted and that paragraph 8 be referred to the executive committee.

This motion was carried.

BRAKE SHOE AND BRAKE BEAM EQUIPMENT.

BRAKE SHOES.

The committee would repeat the recommendation of last year, namely:

"1. That some further work be undertaken by the Association for the purpose of connecting the results obtained under high brake-shoe pressures with those upon which the Association's specifications are based."

Previous to 1911 the tests on brake shoes had been confined to pressures of 2,808, 4,152, 6,840 and 12,000 pounds, and to speeds of 20, 40 and 65 miles per hour.

The tests made by the committee in 1910 at a speed of 80 miles per hour, and at pressures of 9,000, 12,000, 14,000, 16,000, 18,000 and 20,000 pounds, established new standards for high pressure and high speed service.

In order to complete the series and to furnish data for high pressure specifications, it is desirable that some further tests of an intermediate character should be made on the shoes tested in 1910.

The committee accordingly recommends for this year's program tests on these same shoes at a speed of 65 miles per hour and at pressures of 9,000, 12,000, 14,000, 16,000 and 18,000 pounds.

The pressure of 20,000 pounds is not included, since the results obtained in 1910 show that no practical advantage attends the use of pressures higher than 18,000 pounds.

The committee further recommends that from the data thus obtained specifications should be prepared covering the use of shoes in heavy passenger work.

In view of what has been said above, the committee feels that further tests should be made to complete the series and render available for the purposes of the Association the high pressure work already done.

In concluding this part of the report, the committee would make the following recommendations:

1. That further tests be made on the shoes tested in 1910 to connect the results with those previously obtained.
2. These tests to be made at a speed of 65 miles per hour and at pressures varying from 9,000 to 12,000 pounds.

The committee called attention to an appendix showing results of tests made by the New York Central Lines at the laboratory of the American Brake Shoe & Foundry Company, Mahwah, N. J.

BRAKE-BEAM EQUIPMENT.

The recommendations of the committee in regard to minor changes in brake-head drawings, in regard to the numbering of brake beams, the substitution of new M. C. B. Sheet 17, and the adoption of the new brake-beam gauge as recommended practice, were adopted by letter ballot.

The recommendation of the committee in regard to the adoption of standard No. 2 brake beam was rejected. In order to ascertain the reasons for this rejection, and to get further information, the committee addressed a circular letter of inquiry, No. 19, to which reference is here made. The replies to this letter have led the committee to make certain changes in Sheet 17-B, as follows:

The hole at the lower end of strut member in Sheet 17-B is drawn dotted as being optional. It will be noted that the hole in the upper end of the head is also dotted. The committee has found by investigation that it will be difficult to reduce the weight of the beam shown in Sheet 17-B enough to make any appreciable saving without the probability of stresses in the compression member, which would be unsafe for commercial open-hearth steel. The committee would indicate that the new brake-beam gauge shown in Sheet 17-A was accepted for trial, with a view to adoption as recommended practice by letter ballot. The committee would accordingly recommend Sheet 17-A to be accepted as showing the details of the gauges under trial.

The committee would also recommend the beam as shown on M. C. B. Association Sheet 17-B for consideration and trial by members of the Association, with a view of adopting such beam as recommended practice for No. 2 M. C. B. brake beam.

In Circular Letter No. 19 the committee asked whether it was desirable to prepare specifications for the test and inspection of brake beams to be used on passenger train cars. The vote on this question was indeterminate. The committee would ask of the Association, therefore, an expression of opinion as to the advisability of preparing a specification for a brake beam for passenger train cars.

At the 1912 meeting there was a discussion of the report of this committee and the present spacing of brake-beam heads, 60¼ inches, was criticized. It seemed to be the opinion of many members that the distance should be reduced. A circular letter of inquiry, No. 25, was sent out to members by the committee this year, asking for information on this subject. The replies received indicated a majority in favor of reducing the present spacing. In the opinion of the committee, the spacing of 60¼ inches is unnecessarily large and allows the brake beam to shift to one side or the other and to bring the brake shoe on one side beyond the tread of the wheel so as to bear on the outside edge and wear to a shoulder. This can easily be demonstrated by comparing the maximum and minimum distances for brake heads with the standard maximum and minimum gauges of wheels. The committee would accordingly recommend that an average spacing of 60 inches be adopted in place of 60¼ inches, with a maximum spacing of 60⅛ inches and a minimum of 59⅞ inches.

Recapitulating this report with regard to brake equipment, the committee would make the following recommendations:

1. That Sheet 17-A of this report be accepted by the Association as showing the details of the gauges on trial by the Association.
2. That No. 2 brake beam, shown in Sheet 17-B of this report, receive consideration and trial by members of the Association, with a view of adopting such beam as recommended practice for No. 2 M. C. B. brake beams.
3. That the question of preparing a specification for a brake beam for passenger train cars be submitted to the membership of the Association for letter ballot.
4. That a spacing of 60 inches be adopted as a standard for brake-beam heads, with a maximum allowable spacing of 60⅛ inches and a minimum of 59⅞ inches, this spacing to be measured by gauging the inside of the brake-head key lugs.

Committee: PROF. CHARLES H. BENJAMIN (Chairman), C. D. YOUNG, R. B. KENDIG.

Discussion.

F. F. Gaines (Cent. of Ga.)—I move that the recommendations of the committee as to brake shoes be adopted.

This motion was carried.

O. C. Cromwell—I move that the committee be instructed to pre-

pare specifications for passenger brake beams.

This motion was carried.

F. F. Gaines—I move that recommendation No. 4 regarding a 60-inch spacing for brake-beam heads be referred to letter ballot for adoption as standard practice.

This motion was carried.

F. F. Gaines—Referring to recommendation No. 1, I move that it be submitted to letter ballot for adoption as standard practice.

This motion was carried.

R. L. Kleine (Penn.)—I move that recommendation No. 2 be submitted to letter ballot for adoption as recommendation practice.

Herewith followed a discussion with regard to the patent arrangements, and Mr. Kleine incorporated in his motion a sentence referring the question of patents involved to the executive committee and that if satisfactory may be referred to the Association for recommended practice.

This motion was carried.

COUPLER AND DRAFT EQUIPMENT.

The report of the committee on Coupler and Draft Equipment to the 1912 convention was one of progress covering investigation of present types of couplers in service and failures of same; arranging procedure for the designing of a standard coupler; outlining tests—dynamic, static and road; and arranging with the coupler manufacturers to join with the committee in the designing of the standard coupler. As stated in the report of last year, this subject was referred to the executive committee of the Association, who considered same, and under date of June 27, 1912, instructed the committee as follows:

To proceed with the work of designing an M. C. B. standard coupler in conjunction with the coupler manufacturers, using as few of the patents now in force as may be necessary to carry out your ideas.

C. B. Smith, M. E., Boston & Maine, and R. L. Kleine, Chairman of the Coupler Committee.

Following these instructions of the executive committee, the committee continued the work of testing started last year, and jointly with the coupler manufacturers the development of the design of the proposed standard coupler.

Coupler Tests—Static and Dynamic.

The tests outlined in report of last year were conducted by the Pennsylvania Railroad Company under the direct supervision of C. D. Young, engineer of tests and the chairman of the committee. These tests were started April 3, 1912, carried along continuously, using Pennsylvania Railroad testing facilities, as well as those of the Baltimore & Ohio Railroad, the Baldwin Locomotive Works and the Pressed Steel Car Company to expedite the work, and were completed April 24, 1913. A total of 481 tests were made.

The couplers used in these tests comprised the couplers in general use to-day, as well as some reinforced or strengthened couplers which were in course of development, as follows: Pitt, Major, Latrobe, Major Special 103, Gould "Z," Janney "X," Sharon, Krakau, Alliance, Bazeley and Simplex.

With a view of increasing the elastic limit and ultimate strength of the material, experiments were made with heat treatment and varying chemistry. All designs of couplers tested were divided in four groups, each group being subjected to the full list of tests. The four groups comprise the following:

A. Couplers of the regular commercial product.

B. Couplers with the best heat treatment and chemistry which coupler manufacturers could recommend in light of their present experience.

C. Couplers unannealed by the manufacturers with 0.35 per cent carbon low-phosphorus steel, heat-treated by the Pennsylvania Railroad.

D. Couplers unannealed by the manufacturers and made of steel in accordance with their present foundry practice and chemistry, and heat-treated by the Pennsylvania Railroad.

All testing of couplers and separate knuckles has heretofore been made by measuring the ultimate distortion after the final blow as prescribed by the M. C. B. Specifications, but in the tests conducted by the committee the distortions were measured after each drop or pull and tabulated by so much plus or minus from the original dimensions, the idea being to establish the point at which permanent set takes place and study design therefrom. Exhibit 1 shows the location of points, etc.

The results of all the individual tests were plotted graphically as well as summaries of the important dimensions, illustrating permanent set at the various blows or increments of load in each test (jerk, strike, pulling, etc.) for all types of couplers under each grade of material. The four grades of material in each coupler were also compared by summary plots for the various tests. Sheet No. 5,000, Exhibit No. 2, shows the sheet numbers alloted to the individual and summary plots, making a total of 819 plots, of which 479 are individual plots and 340 summaries. The plots of the individual tests are mainly for use of the committee in studying the permanent set of the details of the individual coupler for design purposes, and therefore have been omitted from the report. Of the summary plots, the following have been included in the report:

A. All the summaries in the pulling test of the complete couplers, 30 plots.

B. Comparison of the couplers in the various tests in each grade of material, 87 plots.

The numbers of the plots or test sheets thus included are shown in heavy faced type on Sheet 5,000, Exhibit No. 2, which the committee feels is sufficient to show the comparative strength of the couplers, although the remaining plots are available for publication should they be desired.

Analysis of Results of Tests.

The following comparisons are based upon the "A" material or the present commercial material used in couplers, and are only of a general nature without going into detail. All couplers were given letter designations to represent the names of the couplers tested. Couplers Ta, Ua, Wa, Xa, Xb, Ya and Yc represent couplers of the latest types in general service; couplers Tb, Ub, Yb and Yd represent couplers of increased weight and strength in the development stage, a number of which are in service experimentally.

Pulling Test of Complete Couplers (Pb).—Standard M. C. B. test, 150,000 pounds pull with limit knuckle opening of ⅝ inch ("C" dimension).

Couplers—Present.	Permanent Set at "C" (Knuckle Opening) at 150,000 pounds. Inches.	Load at ⅝ inch Set, M. C. B. Limit. Pounds.	Ultimate Load. Pounds.
Ta	.252	221,000	260,000
Ua	.282	255,000	320,000
Wa	.292	212,000	260,000
Xa	.302	198,000	249,000
Xb	.371	196,000	232,220
Ya	.283	200,000	280,000
Yc	.352	192,000	231,860
Average	.305	210,571	261,725
Experimental.			
Tb	.102	278,000	448,400
Ub	.098	300,000	300,000
Yb	.159	302,000	340,000
Yd	.112	304,000	404,563
Average	.118	296,000	373,241
Increase		40.6%	42.6%
Decrease	61.3%		

Note.—All couplers 5 by 7 inch shank except Ua, which was 5 by 5 inches.

Static Guard-Arm Tests (Pulling) (Hb).—This test was developed on account of the present face test being unsatisfactory from the standpoint of not giving uniform results, mainly due to the variation between the minimum and maximum contour lines, allowing the block to seat higher or lower in the head, thus increasing or decreasing the wedging action. It consists of holding down the guard arm and shank and pulling on the coupler lugs.

Couplers—Present.	Spread between Guard Arm and Lugs "A" at 120,000 Pounds. Inches.	Ultimate Load. Pounds.
Ta	.000	295,000
Ua	.185	216,000
Wa	.192	340,000
Xa	.011	320,000
Xb	.162	280,000
Ya	.176	310,000
Yc	.154	310,000
Average	.126	295,857
Experimental.		
Tb	.066	400,000
Ub	.187	260,000
Yb	*.063	*180,000
Yd	.085	340,000
Average	.113	333,333
Increase		12.7%
Decrease	10.3%	

* On account of Yb coupler being designed not to take any pull on lugs in service, same is not included in the average.

Static Tensile Tests of Coupler Lugs (Ab).—This test was made to ascertain the strength of the coupler lugs in pulling, each lug being pulled separately on a standard diameter pin placed in the knuckle pivot pin hole.

Couplers—Present.	Top Lug.		Bottom Lug.	
	Maximum Load Without Permanent Set "N." Pounds.	Ultimate Load. Pounds.	Maximum Load Without Permanent Set "N." Pounds.	Ultimate Load. Pounds.
Ta	100,000	160,000	80,000	226,000
Ua	120,000	251,810	40,000	222,830
Wa	160,000	273,000	60,000	231,000
Xa	80,000	160,000	160,000	216,000
Xb	40,000	147,400	140,000	218,200
Ya			60,000	210,000
Yc	60,000	248,000	60,000	235,300
Average	93,333	206,701	85,714	220,190
Experimental.				
Tb	40,000	178,000	80,000	261,000
Ub	120,000	215,380	100,000	240,000
Yb	‡40,000	*84,980	‡40,000	*81,820
Yd	60,000	*80,000	60,000	*120,000
Average	73,000	196,690	80,000	250,500
Increase				13.7%
Decrease	21.4%	4.08%	6.7%	

* Small knuckle pin unable to stand higher loads. Not included in average.

‡ Since these lugs are very thin, the design of coupler not requiring them to take any load, they are not included in averages.

Tensile Test of Material (Bb).—This was a regular tensile test of the material in the couplers, using a piece sawed from shank of each coupler. Microscopic photographs (100 diameters) were taken of a section from both the shank and knuckle of each coupler.

Couplers.	Elastic Limit, Pounds, per Square Inch.	Ultimate Strength, Pounds, per Square Inch.	Elastic Limit Divided by Ultimate Strength, Percent.	Elongation Percent in 2 Inches.		
				Actual.	Over Desired.	Under Desired.
Ta	36,690	50,520	72.6	10		17.7
Ua	48,140	87,000	55.3	6		10.
Wa	36,560	66,210	55.2	13		8.1
Xa	20,890	61.620	33.9	6.5		16.2
Xb	36,070	60,720	59.4	18		5.1
Ya	35,120	64,400	54.5	22	0.3	
Yc	31,330	61,740	50.7	13		9.7
Tb	35,550	66,100	53.8	20.5		0.7
Ub	36,320	59,200	61.3	15.5		8.1
Yb	33,130	61,300	54.0	14		8.8
Yd	38,780	67,280	57.6	9		11.8
Average	35,325	64,190	55.0	13.4		8.4

Note.—Desired elongation in 2 inches equals 1,400,000 pounds divided by ultimate strength in pounds.

Static Knuckle Tests, Pulling, Separate Knuckles (Yk).—This test was made to determine the elastic limit and ultimate strength of the separate knuckles. The knuckles were held in a forging by a standard diameter pin through pivot hole, the knuckle tail blocked on lock-bearing area and dummy engaging pulling face.

Couplers—Present.	Greatest Load Before Set Took Place. (Average Top and Bottom) "E" Pounds.	Permanent Set at 150,000 Pounds Load. (Average Top and Bottom) "E" Inches.	Ultimate Load. Pounds.
Ta	120,000	.035	280,000
Ua	100,000	.075	253,860
Wa	80,000	.299	278,310
Xa	80,000	.261	260,000
Xb	80,000	.159	291,850
Ya	60,000	.365	*300,000
Yc	60,000	.278	233,570
Average	82,857	.210	
Experimental.			
Tb	120,000	.038	*300,000
Ub	90,000	.077	239,830
Yb	220,000	.000	‡400,000
Yd	160,000	.000	†230,130
Average	147,500	.029	
Increase	78%		
Decrease		86.2%	

* Test discontinued account reaching capacity of machine.

‡ Pulling dummy failed.

† Test pivot pin failed, small diameter, account design of coupler.

Dynamic Strike Tests, Complete Coupler (Sb).—Standard M. C. B. test, three blows of 1,640 pounds falling 5 feet, and three blows falling 10 feet. Limit of knuckle closure "C" is ¾ inch on bottom after third blow at 5 feet. Limit of axial distortion is 1⅞ inches on bottom after third blow at 10 feet.

Couplers—Present.	Total Blows Given at		Permanent Set "C" (Average Top and Bottom) After		Axial Distortion (Average Top and Bottom) After	
	5 Feet.	10 Feet.	Third Blow at 5 Feet. Inches.	Final Measurement. Inches.	Third Blow at 10 Feet. Inches.	Final Blow. Inches.
Ta	3	3	.468	.999	.812	.812
Ua	3	8	.109	1.812	1.062	1.530
Wa	3	6	.281	1.499	1.531	1.687
Xa	3	6	.025	.780	.906	1.343
Xb	3	2	.265	.499		.562
Ya	3	4	.343	1.140	.781	1.234
Yc	3	5	.140	1.18	.781	1.343
Average	3	4.8	.233	1.135	.979	1.216
Experimental.						
Tb	3	9	104	.767	.812	1.124
Ub	3	8	.116	.809	.781	1.281
Yb	3	10	.074	.783	.437	1.968
Yc	3	5	.116	.562	1.156	1.468
Average	3	8.0	.102	.730	.796	1.460
Increase		66.6%				20%
Decrease			56.2%	35.7%	18.7%	

Note.—All 5 by 7 inch shank except Ua, which was 5 by 5 inches.

Dynamic Guard-Arm Tests, Coupler Body (Gb).—Formerly an M. C. B. standard test now replaced by face test, three blows of 1,640

Couplers—Present.	Total Blows Given at		Permanent Set "A" (Average Top and Bottom) After.		Axial Distortion (Average Top and Bottom) After.	
	3 Feet.	5 Feet.	Fourth Blow at 5 Feet. Inches.	Final Measurement. Inches.	Fourth Blow at 5 Feet. Inches.	Final Blow. Inches.
Ta	3	4	.452	.452	2.062	2.062
Ua	3	4	.265	.265	1.874	1.874
Wa	3	6	.406	.593	1.343	1.843
Xa	3	3		.590		1.014
Xb	3	2		.488		1.468
Ya	3	6	437	.718	.874	1.343
Yc	3	12	296	.828	1.281	2.281
Average	3	5.3	.371	.562	1.487	1.698

EXPERIMENTAL.						
Tb	3	19	.061	.342	1.281	Shank broken.
Ub	3	6	.197	.246	.875	Shank broken.
Yb	3	36	.028	.198	1.375	3.312
Yd	3	15	.140	.487	1.187	2.124
Average	3	19.0	.106	.318	1.179	2.718
Increase		258%				60%
Decrease			71.4%	43.4%	20.7%	

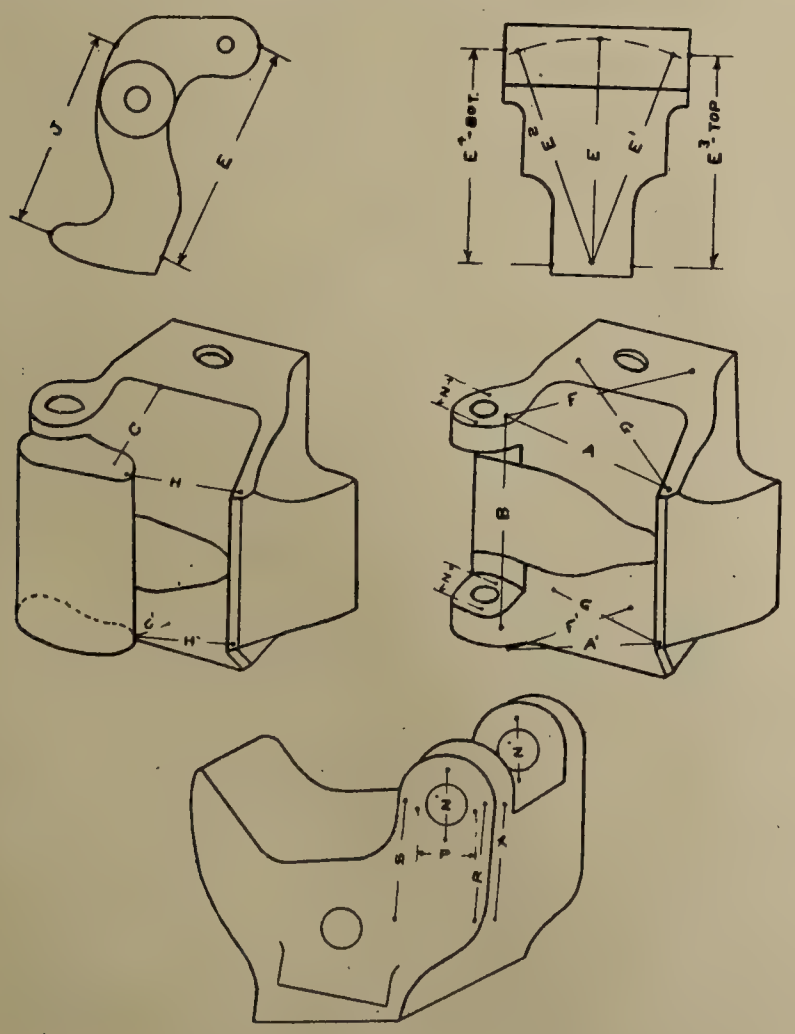
NOTE.—All 5 by 7 inch shank except Ua, which was 5 by 5 inches.

pounds falling 3 feet, and four blows falling 5 feet. Former limits after fourth blow at 5 feet. Guard-arm deflection "A" is $\frac{7}{16}$ inch on bottom. Axial distortion is 1⅞ inches for 5 by 5 inch shank, 1½ inches for 5 by 7 inch shank, measured on bottom.

Dynamic Face Tests, Coupler Body (Fb).—Standard M. C. B. tests, three blows of 1,640 pounds falling 5 feet, and two blows falling 10 feet. Limits after second blow at 10 feet. Guard-arm deflection "A" is ¾ inch on bottom. Axial distortion is $\frac{9}{16}$ inch for 5 by 5 inch shank, $\frac{7}{16}$ inch for 5 by 7 inch shank, measured on bottom.

Couplers—Present	Total Blows Given At		Permanent Set "A" (Average Top and Bottom) After		Axial Distortion (Average Top and Bottom) After	
	5 Feet.	10 Feet.	Second Blow at 10 Feet. Inches.	Final Measurement. Inches.	Second Blow at 10 Feet. Inches.	Final Blow. Inches.
Ta	3	4	.609	.828	.406	.531
Ua	3	2		.562	.187	.187
Wa	3	1		.484		.156
Xa	3	2		.476	.375	.375
Xb	1	0			Head Broken.	Head Broken.
Ya	3	5	.515	.718	.187	.250
Yc	3	3	.640	.718	.187	.250
Average	2.7	2.4	.588	.631	.268	.291
EXPERIMENTAL.						
Tb	3	6	.475	.630	.218	.468
Ub	3	4	.536	.759	.343	Head Broken.
Yb	3	7	.211	.351	.000	.468
Yd	3	3	.276	.276	.000	.125
Average	3	5	.374	.504	.140	353
Increase	11.1%	108%				21.3%
Decrease			36.4%	20.1%	47.7%	

NOTE.—All 5 by 7 inch shank except Ua, which was 5 by 5 inch.



Showing the Dimensions Referred to in Tests of Couplers.

Dynamic Jerk Tests, Complete Couplers (Jb).—Standard M. C. B. test, three blows of 1,640 pounds falling 5 feet, and three blows falling 10 feet. Limit after third blow at 10 feet. Knuckle opening at "C" is ¾ inch, measured on bottom.

Couplers—Present.	Total Blows Given at		Permanent Set "C" (Average Top and Bottom) After		Axial Distortion (Average Top and Bottom) After	
	5 Feet.	10 Feet.	Third Blow at 10 Feet. Inches.	Final Measurement. Inches.	Third Blow at 10 Feet. Inches.	Final Blow. Inches.
Ta	3	5	.374	.468	.156	.202
Ua	3	1		.343		.281
Wa	3	10	.328	.765	.202	.202
Xa	2	0		.110		.062
Xb	3	2		.281		.171
Ya	3	11	.327	.780	.093	.437
Yc	3	10	.406	.859	.156	.156
Average	2.8	5.5	359	.515	.151	.216
EXPERIMENTAL.						
Tb	3	47	.123	.760	.062	.140
Ub	3	8	.324	.419	.000	.000
Yb	3	17	.485	.755	.124	.281
Yd	3	27	—.021	+.148	.093	.343
Average	3	24.7	.228	.520	.070	.191
Increase	7%	349%		1%		
Decrease			36.5%		53.6%	11.6%

NOTE.—All 5 by 7 inch shank except Ua, which was 5 by 5 inch.

Couplers—Present.	Total Blows Given at		Permanent Set Compression "E" After		
	4 Feet.	8 Feet.	Third Blow at 4 Feet. Inches.	Third Blow at 8 Feet. Inches.	Final Measurement. Inches.
Ta	3	3	.107		.325
Ua	3	4	.057	x	x
Wa	3	8	.088	.464	1.020
Xa	3	1	.070		.070
Xb	3	2	.100		.209
Ya	3	3	.110		.435
Yc	3	21	.020	.400	2.540
Average	3	6	.079	.432	.766
EXPERIMENTAL.					
Tb	3	25	.000	.032	.211
Ub	3	8	.035	x	.150
Yb	Not Tested—Small		Pin Hole.		
Yd	Not Tested—Small		Pin Hole.		
Average	3	16.5	.017	.032	.180
Increase	0	175%			
Decrease			78.5%	92.6%	76.5%

x Unable to take measurements on account of pin bending.

Dynamic Knuckle-Strike Tests, Separate Knuckles (Sk).—Standard M. C. B. tests, three blows of 1,640 pounds falling 4 feet, and three blows falling 8 feet. Limit after third blow at 8 feet: No limit on deflection, but knuckle must not break.

Couplers—Present.	Total Blows Given at		Permanent Set Elongation "E" After		
	3 Feet.	6 Feet.	Third Blow at 3 Feet. Inches.	Second Blow at 6 Feet. Inches.	Final Measurement. Inches.
Ta	3	8	.162	.437	.865
Ua	3	6	143	460	.875
Wa	3	5	.234	.608	1.010
Xa	3	7	.125	.417	.480
Xb	3	1	.330		.330
Ya	3	6	250	700	1.260
Yc	3	5	125	.566	.851
Average	3	5.4	196	.531	.810
EXPERIMENTAL.					
Tb	3	17	.034	.213	1 105
Ub	3	1	.090		.090
Yb	Not Tested—Small		Pin Hole.		
Yd	Not Tested—Small		Pin Hole.		
Average	3	9	.062	.213	.597
Increase		66.6%			
Decrease			68.4%	59.9%	26.3%

Dynamic Knuckle-Jerk Tests, Separate Knuckles (Jk).—Standard M. C. B. test, three blows of 1,640 pounds falling 3 feet, and two blows falling 6 feet. Limit after second blow at 6 feet: No limit on deflection, but knuckle must not break.

"A," "B," "C," and "D" Materials.

As stated, the foregoing analysis of tests cover only the "A" material. The "B," "C" and "D" materials, comprising varying chemistry and special annealing or heat treatment, showed, in general, much higher tests, both static and dynamic, as compared with the "A" material or commercial product of the manufacturers. The following comparison on the pull test will serve as an indication of the results of this special treatment, although the dynamic tests are not as uniform as the pulling tests. It is the thought to design the standard coupler on the basis of the present commercial steel, reserving the advantages to be gained by heat treatment for future strengthening of the coupler or detail parts.

"A" = annealed by manufacturers.

"B" =heat-treated by manufacturers.

"C" = approximate .35 per cent carbon, heated to 1,600° F., quenched in water, annealed at 1,100° F.

"D" = approximate .25 per cent carbon, heated to 1,600° F., quenched in water, annealed at 900° F.

Pulling Test of Complete Coupler (Pb).—Standard M. C. B. test, 150,000 pounds pull with limit knuckle opening of 5/8 inch ("C" dimension).

Couplers—Present.	Permanent Set at "C" (Knuckle Opening) at 150,000 Pounds. In Inches.				Ultimate Load in 1,000 Pounds.			
	"A"	"B"	"C"	"D"	"A"	"B"	"C"	"D"
Ta	.252	.076	.008	.093	260.0	322.6	290.0	389.8
Ua	.282	*.125	.070	.177	320.0*	321.9	226.0	428.4
Wa	.292	.369	.145	.222	260.0	272.2	270.0	280.0
Xa	.302	.225	.298	.262	248.0	260.0	270.0	336.0
Xb	.371	.428	.338	.346	232.2	230.0	276.0	292.0
Ya	.283	.246	.217	.267	280.0	310.0	320.5	346.0
Yc	.352	166	.049	.079	231.8	270.0	290.0	335.2
Average	.305	.233	.161	207	261.7	283.8	277.5	343.9
Experimental.								
Tb	.102	.074	.091	.050	448.4	461.5	438.5	480.0
Ub	.098	.077	.095	.101	300.0	388.8	432.0	440.0
Yb	.159	.129	.082	.051	340.0	341.0	421.0	390.0
Yd	.112	.126	.070	.122	404.5	420.0	479.8	436.0
Average	118	.101	084	.081	373.2	402.8	442.6	436.5
Increase					42.6%	41.9%	59.6%	26.9%
Decrease	61.3%	56.7%	47.8%	60.9%				

*All couplers 5 by 7 inch shank except Ua of "A" material, which is 5 by 5 inch.

Road Tests.

Road-service tests were conducted with couplers of present type on freight cars and with couplers of both present and the experimental design on freight locomotive tenders on the Pennsylvania Railroad. The freight car couplers were applied to 100,000 pounds capacity steel hopper cars in the coal trade between the bituminous mines in western Pennsylvania and tide water, a service comprising grade and flat country as well as hump-yard classification. The tender couplers were applied to 7,000-gallon steel tenders in general heavy freight service on the Western Pennsylvania division, between Altoona and Pittsburgh, which includes heavy grade service.

These couplers were also laid off, the bar and parts stenciled and plate labeled, and inspected and measured once every month to determine their operation and ability to withstand service; and thus draw comparisons between the static and dynamic tests with road-service tests.

Couplers.	Bar No.	Date.	Days in Service	C	C^1	H	H^1	E^3	E^4
Ta	620	4- 1-13	246	+.18	+.11	+.04	+.07	+.06	+.05
Ta	621	4- 1-13	246	+.16	+.07	+.06	+.12	+.07	+.04
Ua	600	4- 1-13	246	+.15	+.20	+.11	+.18	+.08	+.05
Ua	601	4- 1-13	246	+.17	+.14	.....	+.11	—.01	.....
Wa	604	5- 6-13	281	+.16	+.24	+.20	+.24	+.01	+.07
Wa	605	5- 6-13	281	+.13	+.25	+.14	+.27	—.02	+.14
Xa	608	4-21-13	266	+.27	+.16	+.14	+.16	+.05	+.07
Xa	609	2-28-13	243	+.14	+.10	+.07	+.16	—.01	—.04
Ya	612	5- 6-13	281	+.22	+.19	+.14	+.16	+.07	+.08
Ya	613	5- 6-13	281	+.16	+.12	+.13	+.26	.....	+.01
Yc	616	4- 8-13	253	+.08	+.11	+.04	+.11	—.02	—.01
Yc	617	4- 8-13	253	+.15	+.14	+.06	+.12	—.02	+.03
Average, all bars			260	+.16	+.15	+.09	+.16	.....	.....
				+.155		+.125		.....	.....

Summary-Freight Car Couplers.

Summary—Freight Car Couplers.—Summary of measurements, showing deflections at "C," "H" and "E" of the twelve couplers of present type in freight car service at last reading is given in the table. All these couplers were in service at the last reading.

Conferences with Coupler Manufacturers.

While the coupler committee was engaged in conducting the foregoing tests, as well as gathering data on the breakage of couplers in service, the gauge of couplers, efficiency of knuckle throwers and lock sets, slack in couplers, etc., the coupler manufacturers were experimenting along the lines of tentative specifications bearing upon the important and fundamental principles involving the detail design of coupler and parts which your committee had previously decided should be incorporated, as far as practicable, in the standard coupler. These tentative specifications had been submitted to the coupler manufacturers for their consideration at the first joint meeting, held March 4, 1912, and were as follows:

Knuckle.

No strain on knuckle pin.

A minimum of 6 square inches knuckle-bearing area on lock, and same to be central with knuckle face.

That the back thrust should be taken on the shoulders of knuckle hub and on back of knuckle shank.

That lost motion between knuckle and lock (1/4 to 3/8 inch now allowed by M. C. B. specifications) be eliminated if possible.

That a smaller knuckle pin than the present standard be used as a pivot pin only, thus making it possible to increase the section through the knuckle hub and coupler lugs.

Lock.

Wedge type, to take up wear.

One piece, if possible.

Lock-bearing area on wall of coupler to be 6 square inches minimum.

Top and bottom unlocking arrangement.

Knuckle Throw.

Bell crank type, which will throw the knuckle from any position and follow it out to the full open position.

Lock Set.

Preferably on some stationary part of the coupler head instead of on a movable part.

Coupler Head.

To be designed to conform to the above details.

Subsequent to the conference of March 4, 1912, joint meetings were held at Altoona, Pa., with the coupler manufacturers on April 26 and May 15, 1912, the results of which were recorded in report to the last convention.

At a meeting of the Coupler Committee, held at Altoona, October 22, 1912, it was decided that sufficient data were at hand taken from couplers in service, as well as from the tests being conducted, to enable your committee to proceed with the coupler manufacturers in designing the proposed standard coupler, and the following method of proceeding with the work was agreed upon:

That the coupler manufacturers be requested to send their mechanical representatives into conference with your committee to take up the design of the standard M. C. B. coupler and to go over the data accumulated as a basis for design. It was ordered that all data sheets be stamped M. C. B. Coupler Committee—*Confidential*, and be distributed with key to same to each coupler manufacturer, with the proviso that the information contained therein should not be used by them for advertising or selling purposes.

The joint committee of representatives of coupler manufacturers and your committee accordingly held meetings to discuss and decide upon details and fundamentals of design, such as operation, contour lines, strength of the various parts, dimensions of knuckle hub and knuckle pin hole, location of knuckle pin hole and lock set, and type of knuckle thrower, etc. Much discussion ensued on these points which are pertinent to design, each one influencing the other to such an extent that full development of any one will handicap the other.

The harmonizing of ideas between the committee and the mechanical representatives of the coupler manufacturers, who have practically devoted their whole life to coupler design, and each previously working along different lines, was gradually accomplished in many of the details

At the suggestion of Mr. Bush, the fundamentals to be used in the design of the coupler or couplers were discussed at one of these meetings, taking the coupler committee's recommendations as a basis, and the following decided upon:

Knuckle:

1. The knuckle should be of uniform strength throughout and should provide for a pull of 200,000 pounds, not exceeding the elastic limit.
2. That the greatest dimension possible through hub is most efficient and desirable.
3. That the point of fulcrum should be as far forward as possible.
4. The center of pivot should not be far from the neutral axis at the hub and toward the back of knuckle.
5. The knuckle should be so designed in connection with other parts as to permit of relieving stress on pivot pin under pull of 200,000 pounds, without permanent set.
6. Knuckle should be so designed that back thrust should be taken on shoulders of hub and back of shank of knuckle.

7. Bearing areas of locking, pulling and buffing should be sufficient to avoid distortion of the surfaces.

8. The center line of vertical dimension of knuckle tail at lock-bearing surface should coincide approximately with the center line of vertical dimensions of head and knuckle face.

Lock:

1. A. Wedge type, to take up wear.
   B. Straight lock.
2. One piece, if possible.
3. There shall be no portion of the lock or lock lifter which may be possible to kink in operation.
4. Lock to be adaptable for top or bottom uncoupling arrangement.
5. Lock must not be cored within the knuckle-bearing area in order that crushing will not take place.
6. Lock must be so designed as not to twist or roll under tension.
7. Lock which requires a reversal of motion in locking is undesirable.
8. Bearing areas for knuckle and coupler wall should be sufficient to avoid distortion of surfaces.
9. Lift of lock to be kept as small as possible.
10. Lock must be so designed as to avoid creeping from locked position.

Lock-set:

1. Preferably on some stationary part of head rather than on any movable part.
2. Lock-set must be so designed that the lock will not be dislodged by jarring, due to uncoupling or switching.
3. Lock-set should preferably be arranged so that the lock can be dislodged by hand.
4. Lock-set should be dislodged at about 60 per cent of the total swing of nose of knuckle.

Knuckle Throw:

1. Bell crank type, which will throw the knuckle from any position and follow it out to the full open position.

At a meeting held at Altoona, Dec. 16 and 17, 1912, the question of determining beforehand the length of head of the standard coupler was brought up and it was decided that this should remain as hitherto, between 9¼ inches and 12¼ inches, keeping as near the former as possible. The question of height of coupler head and total lift was also brought up, and it was decided that this should be investigated on locomotives, passenger and freight cars, with a view of establishing a limit.

The subject of contour lines was then taken up. The National Malleable Castings Company went into the proposition very thoroughly and their Mr. Krakau presented the subject in a very able manner, distributing to each former member present a set of 38 blue-prints, each of which was discussed in detail.

The data on coupling and curving was gotten on a special machine built for this purpose by the National Malleable Castings Company, whose representatives also brought to the meeting an extensive set of adjustable wooden templates to illustrate contour lines. The coupling and curve tests were all made without having any side clearance in carrier iron, in order that they would be strictly comparative. Among the advantages claimed for this straight-line contour are:

1. Idea for buffing forces in having the coupler face and front face of knuckle parallel to each other and both perpendicular to center line of coupler shank. Elimination of buffing forces of nose of knuckle against coupler face of mating coupler, distributing it along whole of face of both couplers and eliminating the wedging condition of knuckles bearing at the same time on both guard arm and face of mating coupler, which causes splitting of coupler faces.

2. Greater diameter of knuckle hub, wherein lies the limitation of knuckle strength.

3. The total number of degrees in the following series of coupling was 77 for two straight-line contours, 68 for two M. C. B. contours, and 67 for the combination of an M. C. B. contour coupling with a straight-line contour.

a.	Both knuckles open.....	When machine is angled toward knuckle side of moving coupler.
b.	Moving knuckle open.....	
c.	Stationary knuckle open...	
d.	Both knuckles open.....	When machine is angled toward guard arm side of moving coupler.
e.	Moving knuckle open.....	
f.	Stationary knuckle open...	

4. The clearance between the coupler face of one and the front of knuckle of mating one of two straight-line contours is about ⅞ inch, which represents initial slack. This initial slack in a coupler having a wedge lock would not increase in service as the present M. C. B. couplers do, and most of which is required for vertical angling. This would eliminate the destructive strains set up by vertical angling in the M. C. B. contour lines in hump and tipple operations.

It being understood that the coupler manufacturers would submit at this meeting models illustrating their ideas of the specifications as laid down, the following full-size steel couplers were submitted and mounted on a rack in the meeting room. A wooden model was submitted by the Monarch Steel Castings Company.

The couplers and other models submitted were examined in detail and for operation, and the fundamentals of each were observed and discussed.

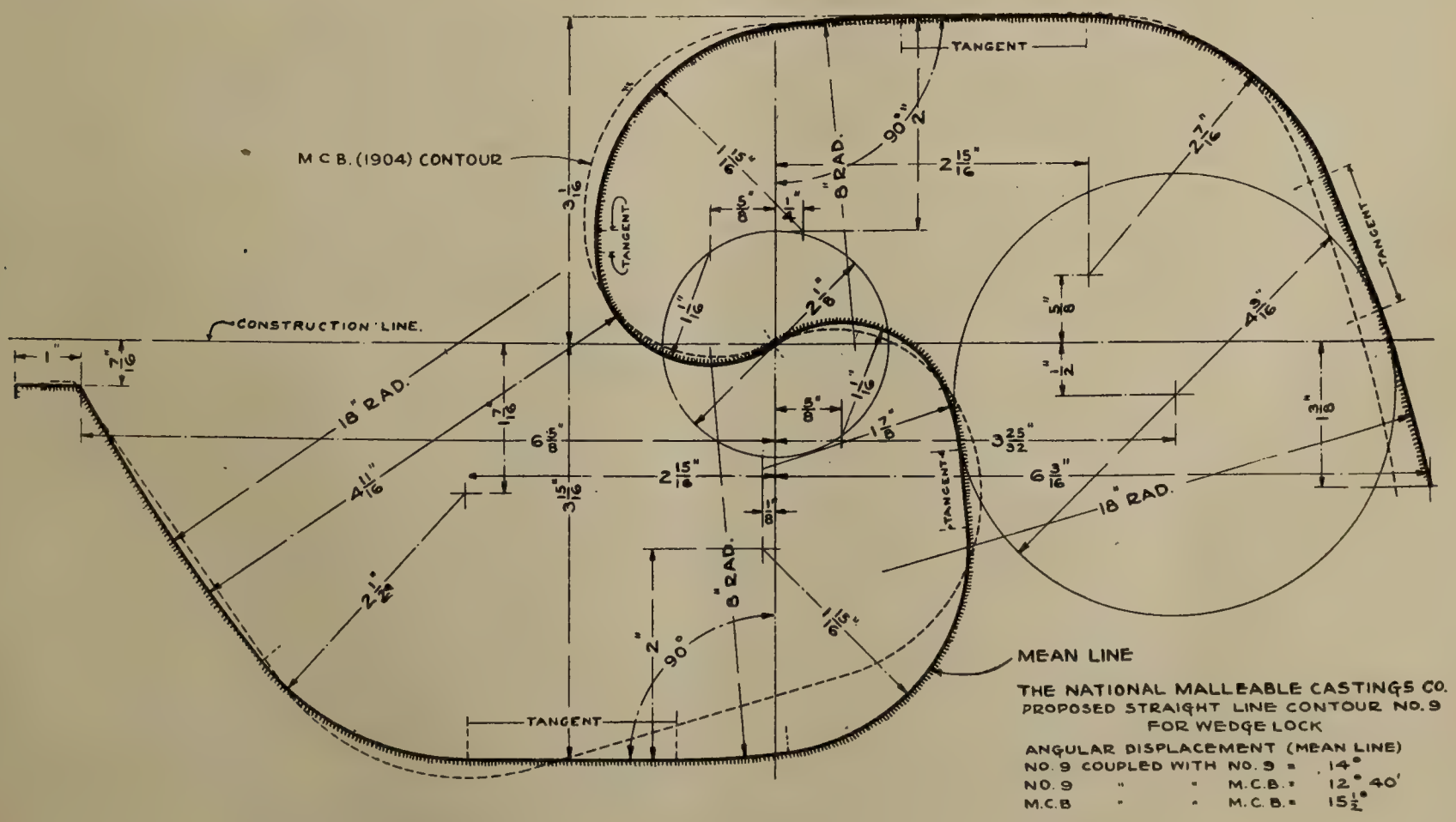
The tentative specifications for the standard coupler, which were revised at the November meeting, were carefully gone over and the following decided upon:

Desired to fix location of knuckle pivot pin at next meeting, the coupler manufacturers to come prepared to definitely locate this fundamental.

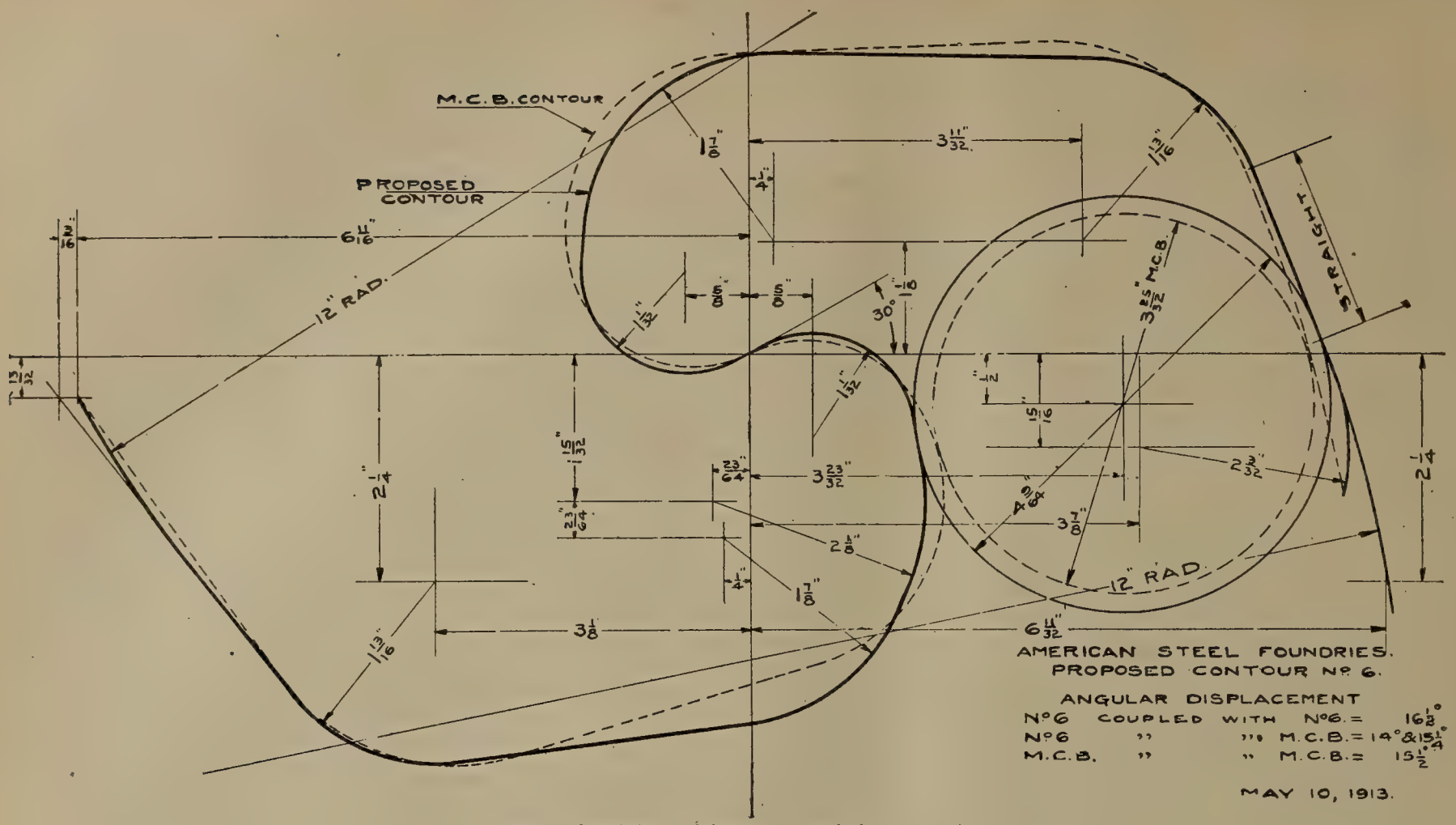
The tripping of the lock-set at a certain per cent of the knuckle swing in opening to be expressed in a definite number of inches from the guard arm measured perpendicularly from guard arm to nearest point of knuckle nose. This was set at 6¼ inches tentatively.

The full opening of knuckle shall be decided at the next meeting and stated in inches from guard arm, measured perpendicularly from guard arm to nearest point of knuckle nose.

The location of the lock-set came up for much discussion, it being decided that the location on the top of front wall of the head is undesirable.



National Malleable Castings Co. Proposed Straight Line Contour for Wedge Lock.



American Steel Foundries Proposed Contour No. 6.

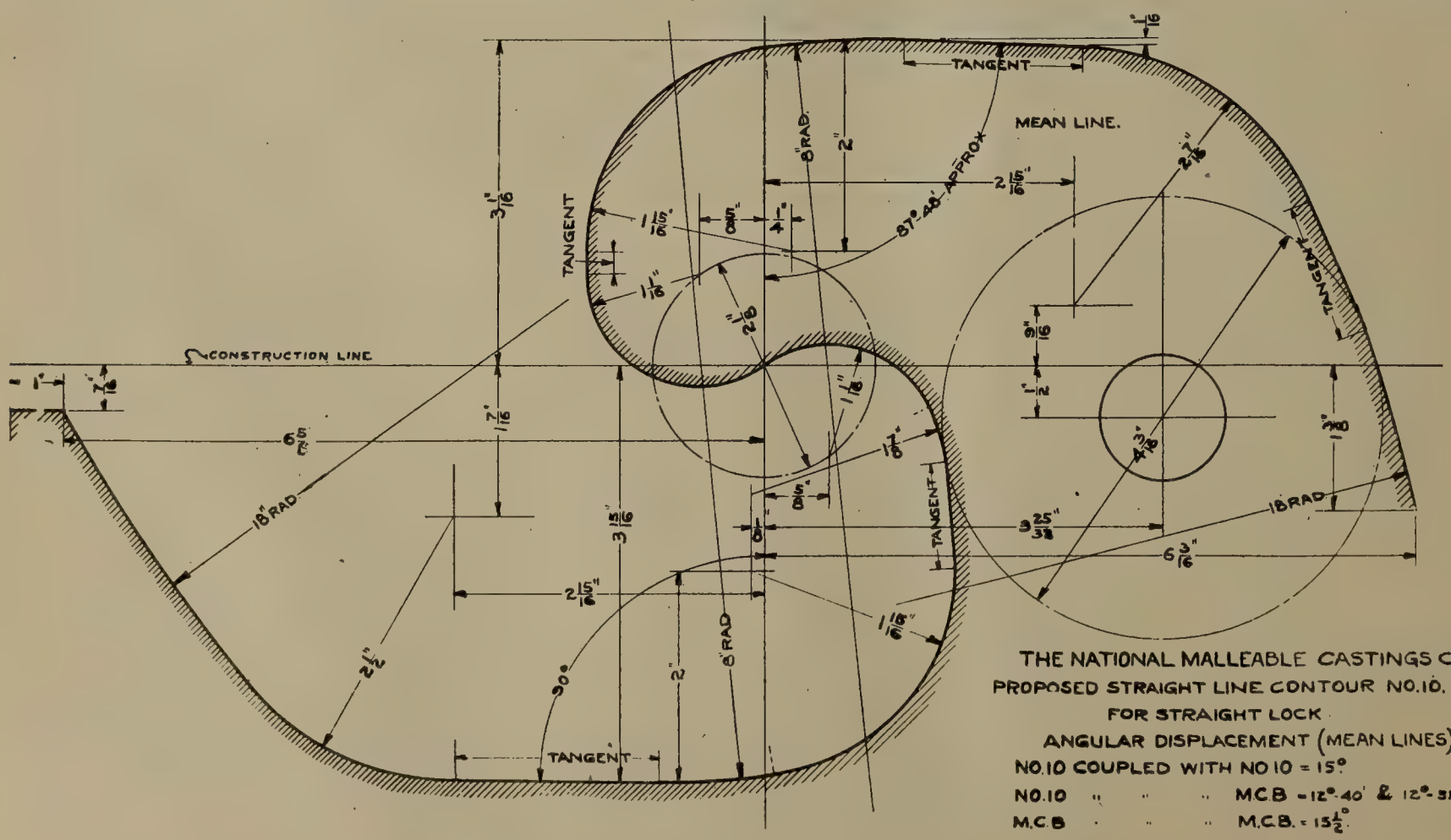
The location of the knuckle pivot pin hole, admittedly very pertinent in coupler design, was again brought up for discussion.

It was agreed that the National Malleable Castings Co. and the American Steel Foundries would give to each other blue-prints of their respective proposed contour lines and each make tests and experiments toward combining the contours to give best results in coupling, curving, buffing, pulling, vertical angling, knuckle strength, etc., in mating with itself and with the present M. C. B. contour. It was also agreed, the American Steel Foundries kindly consenting, that the National Malleable Castings Co. take to Alliance several couplers of wedge-lock type and experiment with them in the jiggling and service machine at that plant in order to more rapidly determine fundamentals concerning the wedge lock, bearing areas, operation, cause of creeping, etc.

Slack.—In connection with the discussion of the contour lines at the joint meeting, December 16 and 17, 1912, a proposed contour line was submitted which provided about ⅞ inch initial slack between two such contour couplers, whereas the slack between two M. C. B. standard contours of mean contour lines is 7-32 inch.

Several members feared this increase in initial slack as being destructive to the coupler in starting trains, but the advocates of the proposed contour explain that the initial slack in this proposed contour would not be materially increased by service when accompanied by a wedge type of lock in the coupler.

It was also claimed that most of this initial slack of ⅞ inch is required for vertical angling of couplers in going over summit of yard humps and coal wharfs, and that couplers of present M. C. B. contour lines are being greatly distorted and damaged in operations of this nature.



National Malleable Castings Co. Proposed Straight Line Contour for Straight Lock.

Most of the members favored the proposed contour lines, providing this initial slack would not prove detrimental; therefore, to accurately ascertain the slack per coupling in couplers in present service the following test was decided upon and carried out: A mixed train of 61 empty cars and an engine was taken in "WJ" west-bound empty receiving yard, Altoona, Pa., January 13 and 14, 1913, and cars separated a distance of about 6 feet, the following data being taken for each end of each car:

Car.—Initials, number and type.

Coupler.—Name, age — old or new, and size of shank.

With the coupler locked, the dimensions "C" and "H" were taken both with the knuckle pulled out by hand against lock, and pushed back by hand, also the distance from guard arm to nose of knuckle with knuckle in full open position. The cars were then coupled and bunched, setting brakes on several cars on both ends to insure the bunching, and each coupler was centrally punched on top of head just back of face and on longitudinal center line of coupler; that is, one coupler of each coupling was center-punched on its center line and with a pair of dividers set at 6½ inches, and with the center-punch hole on one coupler as a center, an arc was described on the other coupler and then center-punched thereon at that coupler's center line, thus getting a uniform distance of 6½ inches between these points. The train was then stretched by a locomotive and brakes set on several cars on both ends to insure stretching, then the distance between the center-punched marks of each coupling above referred to was trammed and the difference between this distance and the original 6½ inches as laid off with cars bunched is the slack per coupling.

The following table shows the information obtained, as well as similar data taken by the N. Y. C. & H. R. R. R. and the C. M. & St. P. Ry.:

		Minimum. Inches.	Maximum. Inches.	Average. Inches.
1. "C"—Knuckle pulled out against lock by hand	P. R. R.	$3\frac{7}{32}$	$4\frac{5}{8}$	3.73
	N. Y. C.	$3\frac{1}{8}$	$4\frac{3}{8}$	3.55
	M. C. B. Std.	$3\frac{9}{32}$	$3\frac{13}{32}$	3.344
2. "C"—Knuckle pushed back by hand	P. R. R.	$2\frac{5}{8}$	$3\frac{7}{16}$	3.03
	N. Y. C.	$2\frac{13}{16}$	$3\frac{3}{4}$	3.02
3. "H"—Knuckle pulled out against lock by hand	P. R. R.	$4\frac{19}{32}$	$5\frac{17}{32}$	4.93
	N. Y. C.	$4\frac{1}{2}$	$5\frac{9}{16}$	4.84
	M. C. B. Std.	$4\frac{17}{32}$	$4\frac{23}{32}$	4.625
4. "H"—Knuckle pushed back by hand	P. R. R.	$3\frac{21}{32}$	$4\frac{5}{8}$	4.24
5. Full opening of knuckle—Guard arm to nose of knuckle	P. R. R.	$8\frac{5}{16}$	$10\frac{13}{16}$	9¼
6. Average play of knuckles, measured on "C"—Item 1 minus Item 2	P. R. R.		0.70	
	N. Y. C.		0.53	
7. Average slack per coupling, Train stretched with locomotive	P. R. R.		1.66	*
	N. Y. C.		1.22	
	C. M. & St. P.		.637	

8. Total slack in couplers—P. R. R. Train—61 couplings, 8 feet, $5\frac{7}{16}$ inches.

9. Total slack in train—P. R. R. Train—61 couplings — including couplers and draft gears, 49 feet, $4\frac{3}{4}$ inches.

10. *Character of equipment measured on.
- P. R. R.—61 old cars and locomotive.
- N. Y. C.—109 cars, new and old.
- C. M. & St. P.—26 new cars.

P. R. R. Train—61 Cars and Locomotives.	N. Y. C. & H. R. R. R. Trains.
32 steel and steel underframe cars. 29 wooden cars. 123 couplers measured—117 old, 6 new.	136 couplers measured on old cars—Average slack per coupling 1.39 in. 82 couplers measured on new cars—Average slack per coupling .96 in. These new cars were built since March 1912, 21 of which couplers were on cars built in December, 1912.

SUMMARY (EXCLUSIVE OF NEW CARS).

TEST ON.	Number of Couplings.	Average Slack. Inches.	Maximum Slack Found. Inches.	Average Gauge. Inches.
P. R. R.	61	1.66	+2⅞	4.93
N. Y. C. & H. R.	68	1.39	*2¼	4.88

+ Gauge of couplers in this coupling, $5\frac{3}{32}$ inches and $5\frac{17}{32}$ inches.

* Gauge of couplers in this coupling, 5 inches and 5⅜ inches.

These tests showed that slack per coupling in couplers in service greatly exceeds the slack per coupling as given in the proposed straight-line contour.

Vertical Angling.—The advocates of the "straight-line" contour, which has about ⅞ inch slack, claim that most of this is required for vertical angling when cars pass over yard humps and coal wharfs and that couplers are being subjected to severe strains in these operations because the M. C. B. contour (mean lines) give only 7-32 inch slack. Vertical angling on humps and the slack available and location of same in the contour lines was illustrated by T. J. Boring, who also showed that the most severe hump on the P. R. R. is one having a 4.46 per cent grade on one side of apex and a 3.07 per cent grade on other side (equaling a 7.53 per cent grade adjacent to level), which with 9-inch face knuckles would require 21-32 inch slack contour lines neglecting the ever variable vertical curve at the apex which the overhang of the cars would often span. Considerable argument ensued concerning the amount of slack available in M. C. B. contour lines for vertical angling as to whether the slack proper in the lines should be counted once or twice. It was demonstrated and finally agreed that 7-32 inch, the clearance in the mean M. C. B. lines, is all that is available for vertical angling, with the understanding that couplers are in tension at the time when the top of pulling face of both knuckles are in contact with each other, which would be at the vertex of any hump having same grade on both sides and couplers of same height. When the latter conditions are not present the knuckles will assume the mentioned position a short distance either side of summit of hump. It was also demonstrated and agreed that the slack per coupling with couplers in bunched position available for starting trains is 7-32 inch, which is clearance in the mean M. C. B. contour lines, plus an equal amount, 7-32 inch, taken from back lash of couplers plus the very small amount which may be gotten by knuckles rotating on the coupling point after the second 7-32 inch just mentioned is taken up.

A compromise was made as to the location of the knuckle pivot pin hole and ½ inch back of coupling line was decided upon for the present.

It was decided that the height of coupler head above center line of shank be set at 8¼ inches tentatively and to be further investigated.

The depth of knuckle hub was set at 10 inches, not counting pivot pin protector lugs, should any be used. To do this it will probably be necessary to reduce the 200,000 pounds elastic limit previously decided upon as desirable. (This was subsequently reduced to 9 inches.)

It was decided that the coupler committee would thresh out the depth of coupler shank among themselves. In the meantime we will consider 6 by 8 inch shank for new cars and 5 by 7 inch shank for existing cars.

The full opening of knuckle was finally decided at 9 inches, with ⅛ inch variation either way measured perpendicularly from guard arm to nearest point of knuckle nose.

It was decided that the maximum total lift of the locking pin should be same as present M. C. B. maximum lift, 6 inches, operated either top or bottom.

At the joint meeting, held in February, 1913, it was agreed that the straight-face contour submitted by the National Malleable Castings Company is based on the correct principles and that a contour line should be developed with the straight face as a basis, incorporating in the same the features of the American Steel Foundries No. 5 contour line and the contour submitted by Mr. Richards of the Gould Coupler Company. The National Malleable Castings Company agreed to do this and submit the new line to the Chairman for approval. This proposed contour was drawn up, approved and tried out on the special coupling and angling machine located at the Cleveland works of the National Malleable Castings Company during the week of March 17, 1913, under the direction of Coupler Committee representatives, Messrs. Kleine, Justus and Boring.

The proposed straight contour line was approved by all members of the M. C. B. Coupler Committee and three of the coupler manufacturers, while two of the latter had not replied and the American Steel Foundries criticized same and submitted their No. 6 contour as one which would give better results, it being a compromise of straight-line face and M. C. B. face with other modifications over present M. C. B. contour.

Since the contour lines are so vastly important and the earnest desire of all is to arrive at the best contour possible, the Chairman decided to give the American Steel Foundries No. 6 contour a try-out, hence the meeting at Cleveland was called to try out and test the various contours and decide upon one as the unanimous recommendation to the M. C. B. Association. The American Steel Foundries agreed to ship to the National Malleable Castings Company at Cleveland two couplers having the No. 6 contour and two couplers having present M. C. B. contour, all with recommended location of knuckle pivot pin.

The first day of the meeting two couplers with proposed straight-line contours and two couplers with present M. C. B. contours were tried out in the machine, mating with themselves and with each other; and during the second day of the meeting two couplers having the American Steel Foundries No. 6 contour were tried out with themselves and with couplers having present M. C. B. contour, both for angling and coupling.

The trials were very closely observed and all points previously brought out and those appearing during the trials were freely and very generally discussed. The American Steel Foundries No. 6 contour gave the greatest range of horizontal angling and coupling, but was not considered satisfactory when compared with the straight lines for taking care of the buffing shocks, and R. E. Janney, representative of the American Steel Foundries, withdrew his No. 6 contour in favor of his No. 5, which latter does not take metal off face of present M. C. B. contour, though it embodies the other modifications for increased strength across knuckle hub and increased angling. It was agreed and proven by tests that with any contour departing from present M. C. B. by taking metal off coupler face, when coupling

with present M. C. B. on straight track and the M. C. B. knuckle open, there will not be contact between nose of M. C. B. knuckle and face of mating coupler throughout the act of coupling, but will require momentum during the last ¼ inch (depending upon design) of locking the M. C. B. knuckle (this does not apply when the knuckle of the straight-line contour is open and the M. C. B. knuckle closed); also that contours with incline of coupler face reduced over present M. C. B., mating with its kind, will require this momentum in closing when couplers are angled.

In summing up the trials, each representative present voiced his views and it was decided that the proposed straight-line contour and a contour not reducing incline of coupler face but embodying enlargement in diameter of knuckle hub and other slight changes over present M. C. B. contour as represented by the American Steel Foundries No. 5 contour, should be given a large and thorough trial in service, with the feeling that if the proposed straight-line contour couplers gave no general trouble in coupling it should be adopted, otherwise we should hold a contour having incline of coupler face not reduced over present M. C. B. contour and make the best of it in buffing, even though it was not designed for sustaining the enormous shocks imposed in buffing in service.

Strength of Couplers.

The general investigation of coupler conditions and the result of tests—static, dynamic and road—conducted by the committee, as well as the great number of couplers and parts requiring renewal, demonstrate beyond a doubt that the present coupler is inadequate in strength to meet the increased demands placed upon it, consequently considerably curtailing its life, which is aside from the desirability of reducing the number of designs to a minimum. The investigations and developments made during the past year have satisfied the committee that this required increase in strength can be accomplished, but the weight of the coupler will necessarily have to be increased from 30 to 40 per cent.

Exhibit of Couplers.

Immediately back of Convention Hall, at the north side of the Pier, the committee had on exhibition various designs of couplers embodying the specifications jointly agreed upon between the coupler manufacturers and the committee, the manufacturers having designed the working parts according to their ideas to meet these specifications.

Experimental Couplers.

After the committee has selected the couplers to be placed in service to be tried out experimentally, and the service tests show that no serious defects exist, the members will be notified which couplers can be recommended for trial purposes; so that a general trial, in limited quantities, can be made by railroads to ascertain their suitability for general service; this trial to be preferably conducted on locomotives. Until this announcement is made the committee must earnestly request the railroad representatives not to apply any new or experimental types of couplers on freight cars which involve new designs unless the parts are interchangeable with present couplers in service, as by so doing it will forestall the work of the committee and, for various reasons, possibly prevent the Association from arriving at a successful issue of the one-standard coupler.

Recommendations for Changes in Standards.

A. The face test, as has been previously stated, is found unsatisfactory along the lines of obtaining uniform results, and while your committee has experimented with the "Hb" tests, see Exhibits 33 and 34, it is not prepared at this time to propose it as a substitute for the face test, but recommends that the "guard-arm test" previously a standard of the Association be again made standard to replace the face test until some more suitable test can be devised.

B. The following was referred to the committee from the committee on Standards and Recommended Practice:

"A member suggests the adoption of three holes for rivets in coupler butt for the attachment of the yoke, claiming that this is a much better practice than the two-rivet combination now standard, and since adopting the same as a standard on the road with which he is connected has had little or no trouble with drawbar yokes, whereas previously it had been a very serious matter, notwithstanding the fact that all rivets were driven hot under a hydraulic riveter."

The committee carefully considered this recommendation but can not concur in the same, for the reason that the addition of another rivet increases the fitting difficulties and involves another standard, both in butt of coupler and yoke design. If a stronger attachment between coupler and draft gear is found to be a general necessity, the solution probably lies in the use of a key.

C. A member writes to the Association as follows:

"We have a 'Y' track connection with another line on a 22 degree curve and we find it impracticable to couple a short tender to a long, modern coach and back the coach around this connection. Our experience indicates that it requires a good coupler side clearance to operate our 16 and 18 degree curves on our main line in the mountains. We are, therefore, very much interested in the subject of coupler side clearance and trust that it will be given proper consideration and result in something that will meet such extreme conditions as we labor under."

The committee would advise that the 2½ inches total coupler side clearance is intended for freight cars and does not apply to tenders with short wheel base coupled to passenger cars with long wheel base and overhang. Unquestionably a case of this kind requires more coupler side clearance than two freight cars of approximately the same wheel base and overhang. In modern steel passenger-car construction it is the practice to use swivel coupler heads attached to shanks or stems having considerable side clearance with spring centering devices to provide for additional side motion; or, when using solid head or shank, the shank is given considerable side clearance. The amount of side clearance is, of course, governed by the degree of curvature and the kind of equipment used, and inasmuch as passenger cars and locomotives are confined to a given territory the construction must be made to suit the conditions imposed. The committee does not feel that a common standard should be adopted to suit all the varying conditions for passenger cars and locomotives.

Committee: R. L. KLEINE (Chairman), G. W. WILDIN, F. W. BRAZIER, J. F. DEVOY, F. H. STARK, H. L. TRIMYER, B. JULIEN.

Discussion.

F. W. Brazier (N. Y. C. & H. R.)—I am a member of the coupler committee and I want to say that you do not realize the amount of work and expense the Pennsylvania R. R. has put in this report. I haven't the least doubt that they have spent $30,000 on it. There are 433 different parts of couplers. Is it not time we got down to a standard coupler? When we do that, instead of carrying 57 different knuckles, we will have one.

J. F. De Voy (C. M. & St. P.)—Although a member of the coupler committee I do not want to take any credit to myself whatever. The railroads should give their support to one of the greatest works which has ever been done by this Association. Also, too much cannot be said about the honesty of the manufacturers in helping the committee arrive at a solution. It is up to every member to go home and get the support of the members to adopt a standard coupler when we get what we want.

J. J. Hennessey (C. M. & St. P.)—I move that the recommendation that no road purchase or put into service these experimental couplers until the committee has made its final recommendation, be carried out.

This motion was carried.

F. F. Gaines (Cent. of Ga.)—With regard to the new contours proposed, I would like to know what we are to do if the present M. C. B. coupler has a spring in it. There are many such in the country.

R. L. Kleine (Penn.)—The coupler committee taboos absolutely springs in couplers. We do not contemplate any closure by hand for if it don't close by impact at slow speed we will not recommend it to the Association.

C. A. Schroyer (C. & N. W.)—I would like to caution the committee to go carefully before changing the present contour lines to any perceptible degree. The contour line used today was shaped so as to obtain the closing of the knuckle without any perceptible slack between the draw bars. The report shows that there is a great deal of slack on cars today and this is due to the bending of the guard arm, wear on the faces of the knuckle and the pin. We took out wedge locks twenty years ago because they could not be kept in position.

R. L. Kleine—I move that the recommendations for changes in standards be submitted to letter ballot.

This motion was carried.

CAR WHEELS.

The committee submitted last year a proposed specification governing dimensions and tolerances for solid wrought-steel wheels for freight and passenger service, which specifications have been since adopted as recommended practice. As explained in last year's report, these specifications did not include rules governing the process of manufacturing the chemical and physical properties of the material, or analysis and tests.

The determination of these questions has constituted the major part of the committee's work this year. The paragraphs added to the specifications are as follows:

I. Manufacture.

1a. Process and discard.

II. Chemical Properties and Tests.

2a. Chemical composition.

2b. Ladle analysis.

2c. Check analysis.

The specification has been revised to include all additions and changes and copy of the complete specifications are attached. It will be noted that no specification is given for physical test of steel wheels as the committee has been unable to determine a proper physical test for solid wrought-steel wheels. A number of experimental tests have been made but sufficient data have not been obtained to decide upon this question. The committee expects to continue its investigations on this subject and report to the next convention.

RECOMMENDATION No. 1.

Specification for solid wrought carbon steel wheels for freight and passenger car service.

I. Manufacture.

1a. Process.—The steel shall be made by the open-hearth process.

1b. Discard.—A sufficient discard shall be made from the top of each ignot from which the blanks are made, to insure freedom from injurious piping and undue segregation.

II. Chemical Properties and Tests.

2a. Chemical Composition.—The steel shall conform to the following requirements as to chemical composition.

	Acid.	Basic.
Carbon	0.60 —0.80	0.65 —0.85 per cent
Manganese	0.55 —0.80	0.55 —0.80 per cent
Silicon	0.15 —0.35	0.10 —0.30 per cent
Phosphorus .....not over	0.05	not over 0.05 per cent
Sulphur .....not over	0.05	not over 0.05 per cent

2b. Ladle Analysis.—To determine whether the material conforms to the requirements specified in Section II, an analysis shall be made by the manufacturer from a test ingot taken during the pouring of each melt. A copy of this analysis shall be given to the purchaser or his representative.

2c. Check Analysis.—A check analysis may be made by the purchaser from any one or more wheels representing each melt and this analysis shall conform to the requirements specified in Section II. A sample may be taken from any one point in the plate; or two samples may be taken, in which case they shall be on radii at right angles to each other. Samples shall not be taken in such a way as to impair the usefulness of the wheel. Drillings for analysis shall be taken by boring entirely through the sample parallel to the axis of the wheel; they shall be clean from scale, oil, and other foreign substances. All drillings from any one wheel shall be thoroughly mixed together.

2d. Limits of Segregation.—The segregation of either element of carbon, manganese, and phosphorus must not exceed 6 per cent of the ladle test of the same melt or any part forming the thickness of the plate and tread and rim of the wheel.

III. Tolerances.

3. Wheels should be furnished rough bored and with faced hubs and have a contour of tread and flange as rolled or machined according to recommended practice Sheet M. C. B. C. They should conform to dimensions specified within the following tolerances:

3a. Height of Flange.—The height of flanges should not be more than ⅛ inch over and must not be under that specified or 1 inch.

3b. Thickness of Flange.—Thickness of flange shall not vary more than $\frac{1}{16}$ inch over or under that specified.

3c. Throat Radius.—The radius of the throat shall not vary more than $\frac{1}{16}$ inch over or under that specified.

3d. Thickness of Rim.—The thickness of rim to be measured between the limit of wear groove and the top of the tread at the point where it joins the fillet at throat of flange. The average thickness of service metal of all wheels in any shipment must not be less than 1¾ inches measured from the limit of wear groove to top tread. The thickness of rim should in no case be less than $\frac{3}{16}$ inches under that specified.

3e. Width of Rim.—The width of rim shall not be more than ⅛ inch less nor more than ⅛ inch over that specified.

3f. Thickness of Plate.—The thickness of the plate of the wheel shall not be less than ¾ inch at the point where the plate joins the fillet at the rim and not less than 1 inch at the point where the plate joins the fillet at the hub. Intermediate minimum thickness to be proportional.

3g. Limit of Wear Groove.—The limit of wear groove to be located as shown in Sheet M. C. B. C. recommended practice.

3h. Diameter of Bore.—The diameter of rough bore shall not vary more than $\frac{1}{16}$ inch above or below that specified. When not specified the rough bore shall be ¼ inch less in diameter than the finished bore subject to the above limitations.

3i. Hub Diameter.—The hub diameter may be either 10 inches or 11 inches in diameter as specified with a maximum variation of ⅛ inch below. The thickness of the wall of the finished bored hub shall not vary more than ⅜ inch at any two points on the same wheel.

3j. Hub Length.—The length of hub shall not vary more than ⅛ inch over or under that specified.

3k. Depression of Hub.—The depression of the hub must be made so that the distance from the outside face of the hub to the line "AB" shall not exceed $1\frac{11}{16}$ inches for wheels used on 5½-inch axles and under and $1\frac{7}{16}$ inches for wheels used on 6 by 11 inch axles.

3l. Black Spots in Hub.—Black spots will be allowed within two inches of the face of the hub, but must not be of such depth that they will not bore out and give clear metal at finished size of bore.

3m. Eccentricity of Bore.—The eccentricity between the tread at its center line and the rough bore shall not exceed 3-64 inch.

3n. Block Marks on Tread.—The maximum height of block marks must not be greater than 1-64 inch.

3o. Rotundity.—All wheels shall be gaged with a ring gage and the opening between the gage and tread at any one point shall not exceed $\frac{1}{16}$ inch.

3p. Plane.—Wheel shall be gaged with a ring gage placed concentric and perpendicular to the axis of the wheel. All points on the back of the rim equidistant from the center shall be within a variation of $\frac{1}{16}$ inch from the plane, of the same gage when so placed.

3q. Tape Sizes.—Wheels shall not vary more than five tapes under nor nine tapes over the size called for.

3r. Mating.—The tape sizes shall be marked in plain figures on each wheel. Wheels must be mated to tape sizes and shipped in pairs.

3s. Gages and tape used shall be M. C. B. Standard or Recommended Practice as follows:

Wheel circumference measure, M. C. B. Standard, Sheet 16-A.
Maximum flange thickness gage, M. C. B. Standard, Sheet 16.
Minimum flange thickness gage, M. C. B. Standard, Sheet 16.
Rotundity gage, M. C. B. Recommended Practice, Sheet C.
Plane gage, M. C. B. Recommended Practice, Sheet C.
Gage for measuring service metal, M. C. B. Recommended Practice, Sheet C-1.

IV. Branding.

The name or brand of the manufacturer, date, and serial number shall be legibly stamped on each wheel in such a way that the wheel may be readily identified. The tape size shall be legibly marked on each wheel, Sheet M. C. B. C-2.

V. Finish.

5. The wheel shall be free from injurious defects, and shall have a workmanlike finish.

5a. Wheels shall not be offered for inspection if covered with paint, rust, or any other substance to such an extent as to hide defects.

VI. Inspection.

6. Inspector representing the purchaser shall have free entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturers' work which concern the manufacturer of the material ordered.

6a. The manufacturer shall afford the inspector, free of cost, all reasonable facilities and necessary gages to satisfy him that the wheels are being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment, and free of cost to the purchaser.

6b. The purchaser may make the tests to govern the acceptance or rejection of material in his own laboratory or elsewhere as may be decided by the purchaser. Such tests, however, shall be made at the expense of the purchaser.

6c. All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

6d. Wheels show injurious defects while being finished by the purchaser shall be rejected, and manufacturer properly notified.

6c. Samples of rejected material must be preserved at the laboratory of the purchaser for one month from date of test report. In case of dissatisfaction with the results of the test, manufacturer may make claim for a re-hearing in that time.

RECOMMENDATION No. 2.

On account of dimension of plates being added to the designs of steel wheels shown in 1912 report, it is recommended that new cuts be made to show the following wheels:

Thirty-three-inch solid steel wheels for 5½ by 10 axles and under, exhibit "A-1."

Thirty-six-inch solid steel wheels for 5½ by 10 axles and under, exhibit "A-2."

Thirty-eight-inch solid steel wheels for 5½ by 10 axles and under, exhibit "A-3."

Thirty-three-inch solid steel wheels for 6 by 11 axles, exhibit "B-1."

Thirty-six-inch solid steel wheels for 6 by 11 inch axle, exhibit "B-2."

Thirty-eight inch solid steel wheels 6 by 11 inch axle, exhibit "B-3."

RECOMMENDATION No. 3.

The present M. C. B. circumference measure for cast-iron wheels has been found unsatisfactory for using with steel or steel-tired wheels, and a new circumference measure as used by most railroads and manufacturers, for taping steel wheels is recommended, as shown on exhibit "T."

RECOMMENDATION No. 4.

It is also recommended that the present standard wheel circumference measure for cast-iron wheels, which has been found unsatisfactory, be discarded and a new design adopted, as shown on drawing, exhibit "U."

RECOMMENDATION No. 5.

In last year's report the committee mentioned the question of establishing a maximum gross load for each design of wheel. This had particular reference to failures of cast-iron wheels used on heavy tare weight, such as refrigerator cars.

The committee has given this matter further consideration and recommends that the titles of the chilled cast-iron wheels shown on M. C. B. Sheets N, O, and P, be changed as follows:

M. C. B. Sheet N, title to be changed from "M. C. B. Recommended Practice for Cast-iron Wheels for 60,000-pound Cars" to "M. C. B. Association Recommended Practice for 33-inch Cast-iron Wheels for Cars of Maximum Gross Weight, not to Exceed 112,000 Pounds."

M. C. B. Sheet O, title to be changed from "M. C. B. Recommended Practice for Cast-iron Wheels for 80,000-pound Cars" to "M. C. B. Recommended Practice for 33-inch Cast-iron Wheels for Cars of Maximum Gross Weight, Not to Exceed 132,000 Pounds."

M. C. B. Sheet P, title to be changed from "M. C. B. Recommended Practice for Cast-iron Wheels for 100,000-pound Cars" to "M. C. B. Recommended Practice for 33-inch Cast-iron Wheels for Cars of Maximum Gross Weight, Not to Exceed 161,000 Pounds."

Committee: Wm. Garstang (Chairman), W. C. A. Henry, A. E. Manchester, R. W. Burnett, R. L. Ettenger, J. A. Pilcher, O. C. Cromwell.

Discussion.

J. R. Onderdonk (B. & O.)—The report states that the limits of segregation of carbon, manganese and phosphorus must not exceed

6% of the ladle test. I think this would be very difficult to live up to. I would like to ask, in selecting these elements, why sulphur was left out?

C. A. Brandt (C. C. C. & St. L.)—The sulphur should have been included. With regard to the 6% limit of segregation, it is included in some roads specifications today and we thought it would be a good thing.

C. D. Young (Penn.)—I question the advisability of a limit of segregation at present for two reasons. In the first place a limit of 6% is too close, with our present methods of determination in the laboratory, and in the second place it would be difficult from the inspection standpoint. I move that recommendation No. 1 be submitted to letter ballot, leaving out at this time the limits of segregation.

D. R. MacBain (L. S. & M. S.)—I move that the Association instruct the committee to investigate further and report on a thickness of flange greater than that now in use.

This motion was carried.

MONDAY, JUNE 16.

Afternoon Session.

REVISION OF THE RULES OF INTERCHANGE.

At the suggestion of the Arbitration Committee, a committee from each of the railway clubs was appointed to consider jointly the proposed changes. A meeting of this joint committee was held in Chicago on April 14, at which meeting representatives from the New England, Central, Pittsburgh, Canadian, Western, St. Louis and Southern and Southwestern Railway Clubs were present.

At the request of several members of the Association, representing cars of private ownership, a hearing was given by the committee on May 6, 1913, at which representatives of the following companies were present: Armour Car Lines, Morris & Co. Refrigerator Line, Swift Refrigerator Transportation Co., Cold Blast Transportation Co., Street's Western Stable Car Line, Mather Stock Car Co., Western Live Stock Express, Missouri River Despatch.

Rule 1.—F. C. Schultz, chief interchange inspector, Chicago, and Chief Interchange Inspectors' Association suggest change:

"Each railway company must give to foreign cars while on its line the same care as to inspection, oiling, packing, adjusting brakes and repairs that it gives to its own cars."

The Joint Club Committee concurs in the first suggestion with the exception that the word "running" precede the word repairs and the arbitration committee approves.

Rule 2.—The committee would recommend that the second paragraph be changed to read as follows:

"Empty cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge. Owners must receive their own cars when offered home for repairs at any point on their lines, subject to the provisions of these rules."

The committee recommends Section (b) of Rule 2 be changed to read as follows:

"Cars loaded with explosives shall be handled in accordance with the regulations of the I. C. C.

"Leaking tank cars containing inflammable liquid must be repaired or transferred without any unnecessary movement, or at nearest available point, with least possible risk.

"Tank cars (empty or loaded) shall be rejected if the safety valve is not stenciled to show it adjusted, etc., within the time limit required by paragraphs 5, 6 and 7 of the M. C. B. specifications for tank cars."

The committee suggests that section *C* read as follows:

"Cars improperly loaded, when not complying with the Rules for Loading Material, or when transfer or rearrangement of lading is necessary."

Rule 5.—W. H. Lewis suggests changing the word "shall" to "must" and "should" to "must." The committee approves.

Rule 7.—The Western Railway Club Car Foremen's Association, Chicago, and Chief Interchange Inspectors' Association suggest change as follows:

"When repairs of any kind are made to foreign cars a billing repair card must be made out. This card must specify fully the repairs made and reason for same, the date and place where made and name of road making repairs; also show location of parts repaired or renewed, as per Rule 14.

"If no bill is to be rendered the billing repair card must be attached to the monthly bill, with the words 'No bill' written across the face of the card."

The Joint Club Committee does not approve. The Arbitration Committee approves recommendations with the modification that the word "billing" shall precede word "repair" in the first line.

Rule 8.—The committee would recommend that Rule 8 be changed to read as follows:

"The billing repair card shall be made in duplicate, the original to be known as billing repair card and the duplicate to be known as record repair card, and to be on forms shown on pages 103 and 104, the items of repairs to be in handwriting."

Rule 9.—The committee recommends that the rule be changed to read as follows:

M. C. B. Couplers, or Parts Thereof, R and R:
  New or secondhand.
  Size of shank.
    (Where 12¼-in. head coupler is applied or removed it must be so stated.)
  Yoke, stem or key attachment.
Wheels and Axles, R and R:
  Cast-iron, cast-steel, rolled or forged-steel or steel-tired wheels.
  New or secondhand.
  Cause of removal (see Rule 10).
Journal Bearings:
  Solid, filled, or other kind, R and R.
  Length of journal.
  Box number (see Rule 14).
Metal Brake Beams or Parts Thereof, R and R:
  Make or name of beam.
  New or secondhand.
  Complete, or part or parts.
  Cause of renewal.
  Part or parts scrapped.
Brake Shoes Applied:
  Cast or reinforced back.
Triple Valve, R and R:
  Make and type.
    (Need not be shown when cleaned only.)

Rule 10.—The committee recommends that after word "groove" add "or preferably by gage shown on M. C. B. Sheet *C1* of the Recommended Practice."

Rule 13.—The committee recommends changing the rule to read as follows:

"Joint evidence card showing copy of billing repair card, covering wrong repairs, when wrong repairs have been corrected, shall be sent to the company issuing such billing repair card, and it shall issue M. C. B. defect card."

Rule 14.—The committee recommends eliminating from this rule any reference to repair card to conform to action on previous rules. In connection with the recommendation to permit the use of a cardholder, the committee believes that eventually a cardholder will be developed which will satisfactorily answer all purposes, but such cardholder should be a standard of the Association, and the property of the Association for the sake of uniformity. The committee does not agree to the introduction of a diagram for locating defects, as it does not feel that the accurate location and extra work entailed therewith is justified.

Rule 15.—The committee recommends that words "repair card" be changed to read "billing repair card."

Rule 17.—F. C. Schultz, C. I. I., suggests that a pamphlet be issued by the committee on standards showing brake beams which meet the M. C. B. requirements.

The Pittsburgh Railway Club suggests adding after the fifth paragraph the following: "Cars built after September 1, 1913, not equipped with either No. 1 or No. 2 brake beams will not be accepted in interchange."

The committee concurs in the suggestion of Mr. Schultz that a pamphlet be issued by the committee on standards showing brake beams which meet the M. C. B. requirements, these brake beams to be used on all new cars built after September 1, 1914. The recommendation of the Pittsburgh Railway Club is approved, except that the committee would recommend that the date be changed from September 1, 1913, to September 1, 1914.

Rule 20.—Twin City Club; J. E. Keegan; Central Railway Club; Pittsburgh Railway Club, and Western Railway Club suggest in first paragraph, last portion, eliminate the words:

"Any company finding cars not within the limits of standard height for couplers may repair and charge the owners."

The committee concurs in these recommendations.

Rule 21.—F. C. Schultz, C. I. I.; Car Foremen's Association; Chief Interchange Inspectors' Association, and Western Railway Club suggest adding to rule:

"When repairs are chargeable to car owners."

The committee approves the suggestion, but would recommend that the wording be changed to read, "when owners are responsible for the defective condition of the roof."

Rule 28.—J. E. Keegan, S. M. P., G. R. & I. Ry.; Pittsburgh Railway Club, and Central Railway Club suggest: Change last two lines to read:

"Not stenciled showing the capacity or maximum weight, or limit weight I or limit weight II."

The committee recommends that the suggestion be adopted.

Rule 29.—The committee recommends amending this rule by striking out the words following "applied" as follows: "under conditions which make them chargeable to the owners"; also to amend that portion of rule reading "diameter of journal must be ⅛ in. greater" to "diameter of the journal must be at least ⅛ in. greater," in order to prevent, under any conditions, the application of axles which may be practically worn to the limit.

Rule 33.—The committee suggests that the rule be made vacant, because a car with missing coupler can not be offered in interchange. The charge which may be made for missing coupler, etc., is provided for in Rule 95.

Rule 36.—Canadian Railway Club: New rule, under delivering companies' defects:

"No car to be accepted in interchange with journal bearings other than M. C. B., standard on cars built after September 1, 1914."

The committee approves of this suggestion.

The committee also recommends a new rule as follows:

After September 1, 1915, cars not having stenciled on them the date when built new, will not be accepted in interchange.

The committee, at the request of the General Managers' Association, would recommend a new rule as follows:

After September 1, 1914, no car carrying products which require for its refrigeration the use of ice and salt will be accepted in interchange unless equipped with suitable device for retaining the brine between icing stations.

Rule 37 to 42, incl.—In regard to various recommendations made to eliminate the combinations under Rules 37 to 42, inclusive, the committee feels that this change would be too radical to be justified at the present time.

It, however, recommends the elimination entirely of Rule 38, because there are very few cases in which the damaged pocket is a factor, except when due to local weak design or inferior material. Similarly, the reference to the pocket in Rule 39 should be omitted. The committee also suggests the omission of the reference to the coupler attachment in the second note at bottom of page 30, following Rule 42.

Rule 43.—The committee suggests the following change:

Owner's Responsibility: "Any damage to underframe of all-steel or steel underframe cars, unless such damage occurred in wreck, derailment, cornering or side-wiping, and except unconcealed fire damage."

Rule 44.—The committee recommends that Rule 44 be made vacant for the reason that under Rule 2 such cars should be rejected in interchange.

Rule 49.—The committee recommends the omission of reference to repair card and the addition of joint evidence cards in this rule.

Rule 50.—W. H. Lewis suggests that this rule be eliminated, as it is covered by Rule 20. The committee approves the suggestion.

Rule 51.—W. H. Lewis suggests that this be eliminated, as Rule 18 covers it.

The committee suggests that this rule be made vacant.

Rule 52.—The committee suggests changing the first paragraph to read:

"Running boards in bad order or insecurely fastened. Bolts, rivets or screws be used on parts repaired."

Also, change third paragraph to read:

"Handholds or grabirons must be of wrought iron or steel. In applying on repairs they must be secured by bolts or rivets.

Rule 53.—The committee suggests that the last line of this rule read: "Also quick-action triple valve, pressure-retaining valve and an efficient hand brake."

Rule 54.—The committee recommends that this rule be eliminated, for the reasons given under Rule 33.

Rule 56.—J. E. Keegan, S. M. P., G. R. & I. Ry.; Central Railway Club, and Western Railway Club suggest substituting Rule 66 in order to place it in its proper place.

The committee approves the suggestion, namely, placing the rule under Rule 56, now vacant, thus putting the rule in its proper place.

Rule 57.—The committee suggests that this rule be changed to Rule 58, and be changed to read as follows:

Delivering Company Responsible: Rule 58. Missing air-brake hose; missing or damaged cylinders, reservoirs, triple valves, angle cocks, cut-out cocks, brake pipe strainers or dirt collectors, pressure-retaining valves, release valves, pipe, pipe fittings, or any parts of these items, except as specified in Rule 59.

Rule 58.—The committee recommends that Rule 58 be changed to Rule 57 and that the first note following the rule be omitted.

The committee recommends that second note following present Rule 58 be amended as follows:

The committee on air-brake hose specifications will submit to the association recommendations for new air-brake hose label, and if the association adopts this label the arbitration committee recommends that after September 1, 1914, no new hose should be purchased or applied unless it bears the revised label, it being understood that the adoption of this recommendation will not penalize any hose now in service or in stock at this time.

Rule 59.—The committee would suggest a revision of this rule as follows:

Owners Responsible: Rule 59. Air hose burst, torn or worn out; air hose labels illegible or missing from wear; air-hose couplings that become defective in fair usage; release valve rods defective or missing; leaky pipe or pipe fittings account rust or seams; broken pipe or pipe fittings account insecure fastenings; defective interior parts of cylinder or triple valve; failure or loss under fair usage of other parts of brakes.

Rule 62.—The committee recommends the elimination of the words "and so labeled" and to allow the balance of the rule to remain as it is.

Rule 65.—The committee recommends change in Rule 65 as follows:

"Journal bearings (regardless of previous condition) and journal-box bolts which require renewal, when delivering company is responsible for change in wheels and axles."

Rule 68.—The committee recommends changing this rule as follows:

"Fast sliding, cast-iron or cast-steel wheels, if spot is 2½ in. or over in length, or if there are two or more adjoining spots, each 2 in. or over in length, the same responsibility to apply to mate wheel, regardless of length of slid spot."

Rule 86.—The Pittsburgh Railway Club suggests adding the 6 in. by 11 in. axle to this rule:

Capacity.	Journal.	Wheel Seat.	Center.
For Cars Marked With Capacity:			
140,000	5½	7⅜	$6\frac{7}{16}$
For Cars Marked Maximum Weight:			
210,000	5½	7⅜	$6\frac{7}{16}$
For Tank Cars Marked Limit Weight I.			
210,000	5½	7⅜	$6\frac{7}{16}$
For Tank Cars Marked Limit Weight II.			
210,000	5½	7⅜	$6\frac{7}{16}$

This is approved by the committee.

Rule 89.—The committee recommends the elimination of Rule 89, for the reason that amended Rule 13 covers this rule.

Rule 90.—The committee recommends the elimination of the first paragraph of Rule 90, as it is already provided for in Rule 13, and would also recommend eliminating the third paragraph of Rule 90 on account of the abolition of the repair card.

Rule 93.—The committee on conference with the Association of American Railway Accounting Officers suggests changing rule to read:

"Separate bills must be rendered for cars destroyed. All charges for repairs made to cars account of owner's defects, defect cards and rebuttal authorities must be consolidated against any one company into one bill.

"Separate statements to be made:

"1. For owner's defects for each calendar month.

"2. For all charges based on defect cards, including rebuttal charges.

"Note.—Totals only of these statements to be shown on the recapitulation."

The committee recommends that present Rule 93 be abrogated, and recommends in its place that new Rule 93, as proposed by the joint committee from the M. C. B. Association and the Association of American Railway Accounting Officers, be adopted.

Rule 95.—The committee recommends the restoration of the third paragraph of this rule shown on page 56, reading:

"Brake levers, lever guides, top and bottom brake rods, whether or not they are lost with the brake beam" to comply with changes made in previous rules and because it is only consistent to feel that if the brake beam when lost is in good condition, the further details as stated above should also be in good condition.

Rule 99.—The committee recommends that this rule read as follows, in order to make it plainer and to conform to Rule 86:

"If car owner elects on account of improper repairs to remove M. C. B. standard axles suitable to the marking of the car, he shall make charge for secondhand axles, and allow credit for secondhand axles if they are in good order. If M. C. B. standard axles unsuitable to the marking of the car are removed, they should be credited as scrap regardless of their condition. Axles removed below the journal limits for cars marked capacity, limit weight or maximum weight, as per Rule 86, should be credited as scrap when removed."

Rule 104.—The committee recommends changing Rule 104 to read as follows:

"Secondhand M. C. B. coupler or parts, or secondhand metal brake beam, may be used in repairs, but must be charged at 75 per cent of value new.

"Secondhand M. C. B. coupler or parts removed, must be credited at 75 per cent of value new. Credits shall be confined to the body, lock, knuckle and knuckle pin, whether secondhand or scrap.

"Secondhand parts of metal brake beams removed must be credited at 50 per cent of value new.

"In applying new M. C. B. coupler or new metal brake beam it shall be so charged, whether or not it be of same make as that removed."

Rule 106.—The committee suggests the elimination of revised Rule 106 as shown on Circular No. 8 giving result of letter ballot on changes in the rules, and restoration of old Rule 106. (See page 66 of the 1912 code) reading as follows:

"No percentage to be added to either labor or material."

Rule 111.—The committee recommends the following change at the bottom of page 86 and top of page 87:

The following basic units must not be used in rendering bills in the foregoing schedule but may only be used in determining cost of other combinations of air-brake repairs not mentioned, for the reason that the present wording is misunderstood.

Rule 112.—The committee recommends rewording this rule, as follows:

"The company on whose line the bodies of trucks are destroyed shall report the fact to the owner immediately after their destruction, and shall have the option of rebuilding or settling for the same."

Rule 115.—The committee approves the recommendation eliminating word "axles" in the second paragraph and concurs in the recommendation changing word "designate" to "nearest," for the reason that such change is in accordance with conference ruling No. 224 of the Interstate Commerce Commission.

The committee suggests changing the last paragraph to read:

The underframe of damaged steel and steel underframe cars, when intact and in serviceable condition, may be forwarded to the owner on defect card, in which case it must be accepted by the owner.

Rule 120.—The committee recommends that wording of the first paragraph of this rule be changed to read as follows:

"A car unsafe to load account of general worn-out condition due to age, decay or corrosion, shall be jointly inspected by the handling line and a representative of owner or a disinterested line whichever can be most conveniently obtained by handling line. If inspectors agree that home route cards are justifiable, joint inspection statement shall be sent to owner, showing in detail all defects found on car, also an estimate of cost of temporary or partial repairs necessary to make car safe to move. Upon receipt of this information, owner shall either furnish two home route cards or authorize destruction of car. When issuing home route cards, car shall be short-routed per Car Service Rule 3, paragraph (f), at owners' expense, and owner shall be responsible for necessary repairs to make car safe to move. If owner elects to have car destroyed, the handling line shall allow credit for all material at M. C. B. scrap prices, less labor cost of destruction.

"The joint inspection and home route cards will apply in cases of direct or indirect connection except where car is already at junction point with car owner's line, in which case owner must accept car per Rule 2."

Rule 121.—The committee recommends that Rule 119 be consolidated with Rule 121, and that the consolidated rule read as follows:

"When the body or trucks of a foreign car are destroyed in wreck or accident, the owner shall, upon request, furnish statement of depreciated value of body and trucks separately.

"If the car is not destroyed, and the owner elects upon request, to furnish home route cards for its movement, it shall be short-routed as per Car Service Rule 3, paragraph (f) to point designated by owner, at the expense of the company on whose line the car was damaged. A joint inspection should be made at said designated point, and settlement made on the basis of the M. C. B. rules."

Rule 131.—The committee suggests that the new rules go into effect October 1, 1913, for the reason that under the operation of the rules from January 1, only about three months' experience would be had with them prior to having recommendations made for changes in the rules.

Passenger Car Rules.

Appendix—Rule 3.—The committee recommends that icing and lubrication be stricken from the items forming line expenses, for the reason that each line interested should be individually responsible for lubrication and icing while the car is on its line. Terminal cleaning is accepted because cleaning of this character is only done at the point where the car starts.

Appendix—Rule 6.—The committee suggests changing rule to read:

"Each operating line at interest may charge one journal bearing only per journal per trip. The following information must be specified on billing repair card or on the bill itself:

"Whether solid, filled, or any other kind, removed and replaced.

"Length of journal.

"Box number."

Appendix—Rule 12.—The committee on train lighting suggests that the following instructions covering repairs to electric-lighting equipment on passenger cars be added to Rule 12, page 129:

"For repairs to electric-lighting equipment on cars in interchange or leased cars, the instructions issued by the manufacturer of the apparatus should be strictly adhered to. In the absence of any agreement, the material furnished and applied must be of the manufacturer's make."

The committee approves the above suggestion.

Discussion.

M. K. Barnum (Chairman)—The arbitration committee has had an unusually strenuous time during the past year, especially on account of the large number of changes suggested in the rules. There were about 280 changes in the freight car rules. While the suggestions have in many cases not been adopted, they have been very carefully considered. The arbitration committee in revising the rules this year has tried to make as few changes as seemed necessary to bring them up to date, and at the same time to keep them as simple as possible. One suggestion, which may not be understood, was that the rules be changed to go into effect October 1, to give the secretary time to get the rules printed and distributed, and also to give the railroads more opportunity to post inspectors on the changes in the rules. The arbitration committee has been advised that Rule 30 has been acted upon by the American Railway Association and the committee wishes a change there, recommending the adoption of American Railway Association Rule 11. That is the rule in regard to weighing cars, and when our report was made we did not understand that that rule had been finally settled upon.

The private car lines representatives present were given a hearing and a lengthy discussion with regard to Rules 4, 33, 35, 36, 64, 94, 98, and 117 followed. Actions taken were as follows:

A motion made by D. R. McBain to adopt the arbitration committee's report with regard to Rule 4 was carried.

A motion made by J. L. Hodgson that action on Rule 4 covered the recommendation for Rule 64 was carried.

E. W. Pratt moved that the time limit for the application of brine retaining tanks to refrigerator cars be extended to September 1, 1915. This motion was carried.

The recommendations of the arbitration committee with regard to Rule 94 were approved on motion.

The recommendation of the price committee as to the change in Rule 98 was taken up and R. L. Kleine moved that it be adopted. This motion was carried.

C. E. Fuller then moved that the report of the arbitration committee be accepted with the exception of the weighing rule, which is changed. This motion was carried.

PRICES FOR LABOR AND MATERIAL.

The committee decided it proper to submit two propositions to be voted upon for Rule No. 98:

First: It is proposed that wheels be settled for, when removed for renewal, on a flat credit rate, in place of having secondhand and scrap prices as heretofore. Flat rate proposed is:

One 36-in. cast-iron wheel.....$5.25
One 33-in. cast-iron wheel..... 4.75

Voting against this proposition will indicate that the present rule will remain without change, except regarding change in price for rolled-steel wheels being reducing from $21 new to $19.50.

Second: It is proposed that cast-steel wheels be settled for when removed for renewal on a flat credit basis, as follows:

One 33-in. cast-steel wheel.....$4.75

A vote against the proposition means that there will be no rate for second-hand or scrap cast-steel wheels.

The committee also recommends that Rule No. 116 be changed as regards settlement price for all steel freight car bodies in place of settling as heretofore, on a price per car body, that the car body be settled for on a pound basis, using the builder's weight of the car when built new. The price recommended is $0.0325 per pound, and the value of car so placed be subject to yearly depreciation as per Rule No. 117.

Rule 98.—Bills rendered for wheels and axles shall be in accordance with the following schedule of prices for material, with the proper debits and credits:

One 36-in. cast-iron wheel..	$10.50	$7.75	$5.25	$10.50	....	$5.25
One 33-in. cast-iron wheel..	9.00	7.00	4.75	9.00	....	4.75
One 33-in. cast-steel wheel..	....	....	....	19.50	....	4.75
One 33-in. forged or rolled steel wheel	21.00	....	4.50	19.50	....	4.50
One axle, 140,000 lbs. (new item)	....	....	....	25.50	$15.25	9.00
One axle, 100,000 lbs.....	20.00	12.00	7.50	19.50	11.75	6.75
One axle, 80,000 lbs.....	16.00	10.00	6.50	16.50	10.00	5.75
One axle, 60,000 lbs.....	14.00	7.75	5.25	13.00	7.75	4.50
One axle, 50,000 lbs. (or under)	10.00	5.00	3.00	10.00	5.00	3.50
And with an additional charge for all labor for each pair of wheels and axles removed from all types of trucks.....	....	....	....	2.25	....	....
Removing, turning and replacing a pair of forged or rolled steel or steel-tired wheels for all types of trucks	....	....	....	3.25	....	....

Rule 101.—The committee suggests that item for labor in this rule be changed from 24 cents per hour to 28 cents per hour. If the recommendation of committee in regard to this change is not accepted, the report should be returned for revision, for the reason that all prices in Rule No. 107 have been arranged on the 28-cent hourly basis. On account of the increased labor rate providing for overhead charges and use of facilities, the committee would recommend the elimination of the 10 per cent additional charge to net total of bills authorized last year.

The following changes are recommended by the committee:

Under repairs of steel or steel parts or composite cars, change "All rivets ½-inch diameter or over, 12 cents net per rivet, which covers, etc.," to read, "All rivets ½-inch diameter or over, 14 cents net per rivet, which covers, etc."

Change—"All ¼-inch rivets and less than ½-inch diameter, 7 cents net per rivet, etc." to read: "All rivets ¼-inch diameter and less than ½-inch diameter, 8 cents net per rivet, etc."

Change—"Straightening or repairing parts in place on damaged cars, also any part that requires straightening, repairing or renewing, not included on rivet basis, 24 cents per hour," to "Straightening or repairing parts in place on damaged cars, also any part that requires straightening, repairing or renewing, not included on rivet basis, 28 cents per hour."

New Items.

Repairs to Steel Tanks of Tank Cars.

Labor for repairing and testing, per hour.....$0.40
Steaming, per tank..... 0.75
Water for testing, per 1,000 gallons..... 0.06

In making repairs to cars on a rivet basis the cost of removing and replacing fixtures not secured by rivet but necessarily removed in order

to repair or renew adjacent defective parts, should be in addition to the rivet basis, rules covering wood car repairs to govern.

Rule 109.—The committee suggested that this rule be changed to read: "When it is necessary to apply any M. C. B. coupler complete, on account of a broken or missing knuckle or lock, the usual labor charge for replacing a coupler can be made.

"When one or more carrier iron bolts over 6 inches long are replaced and pocket coupler at same end of car is removed and replaced, the regular charge for applying carrier iron bolts should be reduced one-fourth hour for each bolt."

Rule 116.—The settlement prices of new eight-wheel cars shall be as follows, with an addition of $27.50 for each car equipped with 8-inch air-brake equipment and $35.00 for 10-inch air-brake equipment. The road destroying a car with air brakes may elect to return the air-brake apparatus, including such attachments as are usually furnished by the air-brake manufacturers, complete and in good condition. The following new items have been added:

Self-clearing hopper, 30 tons, but not less than 40 tons.....$295.00
Self-clearing hopper, 40 tons, but not less than 50 tons..... 315.00
Self-clearing hopper, 50 tons capacity and over..... 400.00

The lengths of the cars above mentioned refer to lengths over the end sills. In the case of double-deck stock cars, $25 may be added to the prices given above for stock cars.

The paragraph reading "Where the capacity of any car other than gondola is 60,000 lbs. or over, 10 per cent should be added to the above prices for the car bodies" should be eliminated.

Change paragraph reading "When cars of 60,000 lbs. capacity or over, and so stenciled, have trucks with journals 4 inches or over, etc.," to read, "When cars of 60,000 lbs. capacity or over, and so stenciled, have trucks with journals 4¼ inches or over, etc."

Change the last two lines of the paragraph reading "When cars are equipped with metal center sills, the following prices shall be added to the values of bodies for cost of such metal sills:

10 inches or less.....$60
Over 10 inches..... 80"

To read:

10 inches or more.....$80
Less than 10 inches..... 60

The committee also recommends that Rule 116 be changed in regard to the settlement price for all-steel freight car bodies, and in place of settling as heretofore on a price per car body, that the car body be settled for on a pound basis, using the builder's weight of the car when new. The price recommended is $0.0325 per pound, and the value of car so fixed subject to yearly depreciation, as per Rule No. 117.

To the prices for box or stock cars with metal underframe and steel framed composite superstructure, add $50 if built with sheathing boards on outside, or $100 if built with sheathing boards on inside only.

	Present Prices.	Proposed Prices.
80,000 lbs. capacity, but under 100,000 lbs., all metal, per pair, but under 140,000 lbs.....	$400.00	$350.00
100,000 lbs. capacity or over, but under 140,000 lbs., all metal, per pair.....	425.00	375.00
140,000 lbs. capacity or over, all metal, per pair.		600.00

Prices include brake beam complete, truck levers, dead lever guides and bottom connection rods. For trucks with steel or steel-tired wheels, an additional allowance of $112 per car shall be made. All trucks in service of 60,000 capacity or over, which consist entirely of metal with the exception of the spring plank, shall be known hereafter as all-metal trucks.

The following changes in depreciation rates were proposed:

In the case of wooden car bodies the depreciation due to age shall be figured at 7 per cent per annum upon the yearly depreciated value.

In the case of wooden car bodies with steel center sills the depreciation due to age shall be figured at 6 per cent per annum upon the yearly depreciated value.

In case of all steel car bodies the depreciation shall be figured at 5 per cent per annum upon the yearly depreciated value.

The depreciation on the tanks or tank cars for handling non-corrosive substances shall be 4 per cent per annum. For tanks or tank cars handling corrosive substances, the depreciation shall be 5 per cent per annum upon the yearly depricated value.

The depreciation of trucks other than all metal shall be figured at 7 per cent per annum upon the yearly depreciated value.

The depreciation on all metal trucks shall be figured at 5 per cent per annum upon the yearly depreciated value.

The allowance for depreciation on wooden car bodies shall in no case exceed 80 per cent of the value when new. The allowance for depreciation on steel underframe or all-steel car bodies shall in no case exceed 60 per cent of the value when new. The allowance for depreciation on trucks other than all metal shall in no case exceed 70 per cent of the value when new. The allowance for depreciation on all metal trucks shall in no case exceed 60 per cent of the value when new. The allowance for depreciation of wooden car bodies with steel center sills shall in no case exceed 70 per cent of the value when new.

Passenger Equipment.

Rule 7.—Change to read: "No labor charge shall be made for applying brake shoes, incandescent bulbs, gas domes, gas globes, gas bulbs, gas bowls, gas pillars, journal bearings, hose (air, steam or signal), mantles, tips, filling lamps, charging batteries, gasing tanks, icing and coaling cars."

Committee: F. H. Clark (Chairman), G. E. Carson, Ira Everett, J. F. Dunn, S. T. Park, H. E. Passmore, C. F. Thiele.

Discussion.

After presenting the report, F. H. Clark read a resolution which had been adopted by the American Railway Association, with regard to increasing the cost for reweighing and remarking, and stating that as a result the committee proposed to change Rule 107 to increase the prices to $1.00 and $1.25 respectively. It was moved that the report be adopted, with the exception of the recommendations as to depreciation, which remain the same, and that it be incorporated in the rules of interchange. This motion was carried.

FREIGHT CAR REPAIR BILLS.

The committee appointed to confer with subcommittee of the Association of American Railway Accounting Officers regarding freight car repair bills recommends that the following rules of the Association of American Railway Accounting Officers be observed when rendering or correcting bills:

A. Bills should not be rendered for amounts less than twenty-five cents (25 cents) in aggregate, but charges for items less than twenty-five cents (25 cents) may be held until they amount to that sum, provided said aggregate is rendered within sixty (60) days.

B. No bills should be returned for correcting on account of incorrect car numbers, but shall be passed for payment at once and the alleged errors in car numbers brought to the attention of the company rendering same within sixty (60) days from date of receipt of bill.

The billing company shall furnish correct car reference, or shall issue within thirty (30) days counter charge authority, as per Form 1 attached.

C. No bills shall be returned for correction on account of other error or questionable charges unless the net amount involved exceeds 10 per cent of the total amount of bill, but shall be passed for payment at once and the alleged error brought to the attention of the billing company within sixty (60) days from date of receipt of bill. The billing road must furnish proper explanation or shall issue, within thirty (30) days counter charge authority on Form 1.

D. Undercharges shall be similarly adjusted on regular authority of the company against which the bill has been rendered.

E. When bills are returned for correction, all defect cards and billing repair cards, except those in question, must be retained by the company against which the bill has been rendered.

Form 1.

M. C. B. ASSOCIATION—COUNTERBILLING AUTHORITY.

(Name of Railroad)

Place.....191..

This will authorize the .....Railroad Company to counterbill the.....Railroad Company .....Dollars to offset overcharge in our bill No..... Amount, $..... $..... .....

This authority must be attached to bill. Signature of person issuing.

Committee: D. F. Crawford (Chairman), C. E. Fuller, M. K. Barnum.

This report was adopted.

ABUSE OF THE REPAIR CARD.

A committee representing the Association of American Railway Accounting Officers and Master Car Builders' Association met at the La Salle Hotel, Chicago, April 8, 1913, to consider this subject, particularly as to alleged irregularities practiced by some railroads in rendering bills for repairs to cars, as referred to by F. A. Delano in his letter, dated December 24, 1912, to the executive committee of the Master Car Builders' Association.

The letter from Mr. Delano was read carefully, and his suggestions were given due consideration. Mr. Delano's third suggestion was taken up first and thoroughly discussed, and it was the unanimous opinion of the committee that the handling company should not be expected to assume the expense in connection with the application of M. C. B. knuckles, air hose, brasses, etc., as the committee felt that this plan would not furnish the desired relief, but, on the other hand, would place a burden on those railroads which aim to keep their cars in first-class condition for service by imposing additional expense of partially maintaining the cars of other railroads who do not maintain their own cars in a serviceable condition.

The committee believes that in some instances the price for labor and material established by the M. C. B. Association are less than cost, if supervision, the use of facilities and tools and other shop expenses are taken into consideration. This has a tendency to cause some car owners to encourage the making of repairs to cars by the handling company. Therefore we suggest that the Master Car Builders' Association make such changes in the allowances for labor and material as will more nearly represent the actual cost of repairs.

Relative to the first suggestion in Mr. Delano's letter, the committee agrees with this suggestion, and to enable the car owners to make a

check of the car repair bills on basis of car days, recommends that M. C. B. Rule 93 be changed to read as follows:

"Rule 93. Separate bills must be rendered for cars destroyed."

All charges for repairs made to cars account of owners' defects, defect cards and rebuttal authorities must be consolidated against any one company into one bill.

Separate statements to be made:

First. For owners' defects for each calendar month.

Second. For all charges based on defect cards, including rebuttal charges.

Note.—Totals only of these statements to be shown on the recapitulation.

If the above rule, as amended, is complied with, it will, we believe, enable a car owner to readily ascertain from time to time the exact amount charged his company for car repairs per car day on any line in any given period. Your committee is of the opinion that no practical method can be devised to check car repair bills, by which dishonest practices can be positively detected—and, further, we are unwilling to believe that dishonest methods are being employed, excepting in isolated cases.

It is the opinion of the joint committee that the Interchange rules of the Master Car Builders' Association as now formulated, if honestly followed, are perfectly fair and equitable to all car owners, and further believes that the enforcing of honest methods in connection with repairing of cars and making repair bills is something which is to a very large extent under the control of the ranking officials of each company. The recommendation of your committee therefore is that the officer in charge of the mechanical department of each railroad and company look into the practice of making repairs to foreign cars and rendering bills for such cars repaired on his own line, with a view of seeing that the work is honestly performed, and also that the bills are rendered only for defects for which the car owner is responsible.

The committee on abuse of the repair card approves the report and recommendations of the joint committee, and recommends that Rule 93 be changed in accordance therewith at the June convention, and recommends further that the attention of all members be again called to the resolution passed in 1909, with the request that where any evidence of improper use of the repair card is available that it be submitted to the executive committee for appropriate action.

Committee: D. F. Crawford (Chairman), C. E. Fuller, M. K. Barnum.

TUESDAY, JUNE 17.

SAFETY APPLIANCES.

Owing to the magnitude of the safety appliance work and the many complications entering into the same, your committee on safety appliances does not feel that at this time it can render any report other than a general statement of the conditions. Our investigation develops that the roads are making diligent effort to equip their cars with safety appliances to meet the requirements of the law. We would earnestly recommend that the importance of this matter be kept before the members.

In some instances we found that the stenciling "United States Safety Appliances" on the cars was not being done in accordance with M. C. B. Sheet "G," and for the benefit of all concerned we have recommended to the arbitration committee that a note be added after Rule 52, on page 34 of the M. C. B. Code, which will indicate the location and manner of stenciling cars equipped with United States safety appliances.

The committee recommends that no further changes be made for the present in the interchange rules so far as safety appliances are concerned.

Committee: C. E. Fuller (Chairman), A. Stewart, A. La Mar, H. Bartlett, M. K. Barnum, W. O. Thompson, C. B. Young.

Discussion.

F. F. Gaines—I move that the committee be continued and instructed to look into the question of getting an extension or continuation on some points.

This suggestion was referred to the executive committee.

RULES FOR LOADING MATERIALS.

The committee recommends a change in the title of the code of rules from "Rules for Loading Materials" to "M. C. B. Loading Rules."

Rule 7.—This rule should be changed to read: "Lading will not be accepted if placed on top of box or stock cars. If lading is placed on top of wooden cars having sides not more than 30 inches high, and not less than 3 inches thick," and so on.

Rule 10 (second paragraph).—Change the word "should" to "must," which would make this paragraph read as follows: "If the idler is a flat car of wooden construction its capacity must not be less than that of the carrying cars."

Rule 17.—Add "and must conform to Rule 51," to the end of the rule.

Rule 18.—In order to make this rule agree with the safety appliance laws it should be made to read as follows:

"A group of cars must have at least one accessible and operative hand brake for two or three cars; or two hand brakes for more than three cars."

Rule 30.—This rule should be changed to read as follows:

"Material in open cars requiring special staking or clamping, and all material carried on two or three cars, must always be examined by a competent inspector before the cars are moved from the loading point. If an inspector is not stationed at the loading point, the agent must give notice to the proper authority when the cars are loaded, so proper inspection may be arranged for. The object of such inspection is to see that these regulations have been complied with."

Rule 67.—Rule changed to read:

"Flat cars loaded with crossties, fence posts or similar short material will not be accepted for shipment, unless otherwise agreed."

Rules 69, 70, 71.—These rules are changed to read as follows:

"Rule 69.—If the load extends more than 12 inches above end or end gate at center, each pile must be tied across by at least two binders. Each binder is to be fastened to each tie in passing over the load (see Rules 70 and 71 for manner of securing binders)."

"Rule 70.—When wire is used it must not be less than good ⅛-inch diameter, and but one strand may be used, the wire to be secured to the side of car at least three nails or staples, or to stake pockets, or through holes in top of flange on side of steel cars, or fastened to outside edge of first tie projecting above car side."

"Rule 71.—When sapling is used it must be of green timber, split, and not less than 1½ inches wide on the split or flat side. The ends of the sapling must extend at least 12 inches below car side and be securely fastened to each tie with nails in passing over the load."

Rule 74A.—The following new rule has been added:

"Rule 74A.—Small steel plates and similar material loaded in box, stock or gondola cars—the load should be uniformly distributed over the floor of the car. In no case should the amount of load placed between the body bolsters at either end of car exceed 15 per cent of the capacity of cars with wooden underframing, and 20 per cent of the capacity of cars with steel underframing."

Rule 81D.—To make this rule conform to Fig. 33B, after the word "car," in fourth line, should be inserted, "On the same side of car two (2) straight-grain hardwood pieces 4 inches by 6 inches to be securely fastened to car side; the other side supported by three (3) vertical straight-grain hardwood posts 6 inches by 8 inches in section, and of sufficient height that when plates are placed diagonally across the car they will extend from one side across to full width of upright posts."

Rule 82.—Add to the end of this rule the following:

"Where the weight of overhang is not excessive and material very flexible, a 6 inch by 8 inch post of sufficient length may be bolted to inside of end of car to support overhang in lieu of sliding pieces placed on adjacent car."

Rule 85.—This rule should be changed to read as follows:

"The method of loading as shown by Figs. 34, 35 and 36 may be made use of to load long lattice girders, box girders, columns, one-half roof trusses and similar material, in lengths not to exceed 65 feet, overhang not to exceed 16 feet—height and width to conform to Rule 25, if the material would be injured if loaded on more than one car. From a point of safety in transit, it is a very undesirable method and should be used only when absolutely necessary."

Rule 91.—Change side clearances from 18 inches to 22 inches to conform to changes in Rule 51.

Rule 93.—In order to cover triple loads of long, flexible material, this rule should be changed to read as follows:

"Long, flexible material like plates, etc., which cannot be loaded as shown in Fig. 24, must be loaded on two (2) bearing pieces and two (2) or more sliding pieces as in Figs. 41, 42, 43, 43-A and 43-B. The sliding pieces must be 4 inches lower than the bearing pieces and must have flat iron ½ inch by 6 inches secured to the upper side, either with spikes or lag screws, at each end. These iron pieces, which are intended to facilitate curving, must extend at least 22 inches beyond each side of the lading and must be coated with grease before the lading is placed upon them. The bearing pieces must be secured to the car and the material clamped together in the same manner as described in Rules 72 and 80, to prevent it from shifting."

Rule 98.—The last sentence should be changed to read:

"Rolling freight must be loaded longitudinally with car and must be chocked to prevent end and side motion."

Rule 103.—"All structural material and plates more than 60 feet long, also," should be eliminated, as this class of lading is covered by Rule 93.

Rule 112.—The following should be added to this rule:

"Pipe 8 feet or less in length, side and end protection must be provided."

Rule 112A.—On account of the difficulty experienced handling pipe where small sizes have been placed inside of larger pipe, a rule prohibiting the practice has been suggested, to read as follows, and shown as second and third paragraphs of Rule 112A:

"Wrought-iron pipe of the smaller sizes, approximately 1½ inches in diameter and less, should not be loaded inside of larger sizes of pipe, unless below the ends or end gates of cars."

"Wrought-iron pipe of the smaller sizes, approximately 1½ inches in diameter and less, should not be loaded on top of the larger sizes of pipe, unless the load is below the ends or end gates of cars, except where the smaller pipe is securely tied in bundles."

Rules 112B and 115.—Omit the last sentence in brackets, reading:

"(See Rule 112 for wiring and staking)."

Rule 115A.—Add after the word "pipe," the last word on page 105, the following: "Provided that blocking more than 10 inches in height will not be required."

Rule 116.—This rule has been revised to conform to the present method of loading, as follows:

"Blocking of more than 10 inches in height will not be required, but on loads of pipe 3 feet or over in diameter the blocking must be stayed by suitable chocking."

Rule 117A.—This rule should read as follows:

"Gondola cars. Galvanized-iron culvert pipe of all sizes, for size and number of stakes to be used, see Rules 12 and 112. When mixed sizes are loaded on the same car, the small size pipe, when possible, should be placed inside the large size. In loading galvanized pipe Rule 9 must be complied with."

Rule 117C.—This rule should read as follows:

"Mining cars and similar vehicles; the length of cars being equal to or greater than twice the height of car side, if loaded in gondola cars on ends, the broad side or bottom must be loaded parallel with car side and securely blocked against side of car, the other ends brought together in a cone shape. Each pair of cars or vehicles must be securely fastened together on each side with a board not less than 1 by 6 inches, bolted to each car or vehicle with one ⅝-inch bolt, the entire load to be tied together with four strands, two wrappings of good ⅛-inch diameter wire. The blocking must be of sound timber not less than 6 inches by 6 inches square. Fig. 61A shows substantially how the load is to be secured."

On page 108, first line under the heading, "End Protection," should be changed to read as follows:

"Cars not provided with end stake pockets, the necessary," etc., and after "or" in first line on page 109, the word "two" should be inserted.

Rule 121.—Last sentence in second paragraph should be changed to read as follows:

"End blocking to be not less than 6 inches in height, bolted to car floor and securely cleated." Fig. 64B should be changed to conform to the above change in the rule. Four-inch blocking is not sufficient to hold boilers and tanks over 8 feet in diameter on flat cars.

Rule 121A.—Should be added to the code to cover shipment of smokestacks on same car with boiler. This rule to read as follows:

"When smokestacks are shipped on same car with boiler, not less than 4 inch by 4 inch stakes should be applied to each side of car, and each pair of stakes tied together with 1 inch by 5 inch cross braces, nailed to each side of stakes with 3 tenpenny nails. The smokestacks should be loaded on top of cross braces and securely wired to them with ⅛-inch diameter wire. The projection of stakes above cross brace should not be less than one-half of the diameter of smokestack."

Rule 121B.—This rule should read as follows:

"Engines, machinery and vehicles shipped on their own wheels should have wheels securely chocked fore and aft and longitudinal sills placed on the inside of wheels and securely fastened to floor of car. Struts should be used to prevent the heavy parts of the engine shifting endwise. One end of the strut should be placed against some strong protection on engine, machine or vehicle—the other end securely fastened to floor of car."

Rule 122.—Fig. 64 shows three horizontal tie braces, instead of one.

Rule 122A.—The 2 inch by 4 inch diagonal braces to axle journals now shown in Figs. 66B and 66C should be eliminated and angular chocks 8 inches in height against wheel tread, spiked to car floor, should be substituted.

Rules 127 and 127A.—These rules should read as follows:

"Rule 127.—Hewed ties 8 feet or more in length, or sawed ties of lengths 8 feet to 12 feet, or similar material which does not conform to Rule 126, may be loaded longitudinally in four tiers, as per Fig. 71, in which case the ends of the tiers next to the end of car and end of ties projecting into the doorways must rest on bearing pieces not less than 6 inches thick, laid crosswise on floor of car. If the length of car is such that ties cannot be piled in four tiers, three tiers may be used as shown in Fig. 72, in which case the spaces between the ties must be blocked to prevent any shifting of the middle tier. When loaded in three or four tiers as indicated the door protection strips need not be applied.

"Rule 127A.—Sawed ties more than 12 feet in length (see rules for loading lumber)."

Rule 132.—A paragraph should be added as follows:

"To protect the ends of cars loaded with greased shaftings, boards 2½ inches thick, full width of car and to height of lading, should be securely nailed to end of car."

Rule 133.—This rule to read as follows:

"If box cars are used for loading heavy machinery, such as lathes, planers, boring machines, etc., each machine should be blocked by securely nailing to floor of car 2 inch by 4 inch hardwood strips fore and aft, to prevent shifting endwise."

New Rule 134.—Automobiles should have gasoline and water tanks emptied and batteries disconnected. If electric automobiles, remove batteries. Place automobile in car parallel with sides of car. See that front wheels are in line with back wheels. Set brakes. The lower third of tires should be wrapped with at least two thicknesses of good burlap to prevent chafing. Secure each wheel with bands of good strong material (canvas preferred) fastened with 2 inch by 4 inch by 12 inch sound wood blocks, placed on each side parallel with wheel, and securely nailed to car floor to prevent bands from pulling loose. Each wheel should be chocked fore and aft with angular chocking one-third the height and 2 inches wider than wheel. The chocking of each wheel should be tied together with a board on each side of wheel, securely nailed to the chocks. To preserve alignment of the front wheels, small ropes tightly drawn should be fastened from the top of one wheel to the bottom of the other. Burlap should be placed around wheels under rope to protect paint. When shipped without tires, no part of the wheel except center of rim should come in contact with the chocking. In addition to chocking referred to, an iron band not less than 1¼ inches wide and not less than 18 gage in thickness should be passed over top of wheel and securely fastened to chocking.

Committee: A. KEARNEY (Chairman), R. E. SMITH, L. H. TURNER, W. F. KIESEL, C. N. SWANSON, G. H. GILMAN, J. M. BARROWDALE.

The committee stated that Rule No. 93 is to be modified to the extent that it will allow a uniform plate of 1¼ inches. Under Rule No. 117A there should be added to the code to cover shipment of galvanized corrugated sheet iron culvert pipe. The committee also made the following changes in its report:

Rule 12.—Add to first sentence, fourth line, "or rolled or built-up steel sections of equal strength."

Rules 15A, B and C.—Make reference to the use of "sliding pieces" as well as "bearing pieces."

Rule 15E.—Make reference to 15C.

Rule 15E.—In order to make the rule correspond to the figures, it should be changed as follows:

"For twin or triple loads of long, flexible material, such as plates or similar lading, requiring two or more sliding pieces in addition to the bearing pieces, the weight of lading must not exceed one-half the capacity of car, and must conform to Figs. 41, 42, 43, 43A and 43B.

"For material of less flexibility, such as heavy channels and I-beams, see rules 15A, B and C and Figs. 39 and 40.

"For tee and girder rails 60 to 65 feet long, loaded on flat cars, having four or more stress rods, or on gondolas with deep ends, the lading may equal the marked capacity of car."

Rule 22.—Add to end of second section: "Or rolled or built-up steel construction."

Rule 24.—Change to read: "The preferable distance between bearing pieces under lading on two or more cars is 7-10 the total length of lading, with allowable variation from 6-10 to 8-10."

Fig. 12.—Add to the heading, "Rule 91."

Fig. 29.—Omit the words "in bundles" in notes.

Add Fig. 33A to second line of heading to table covering maximum weight of load.

Fig. 43.—Add the word "flexible" to heading, after the word "material."

Rule 74.—Reference to Fig. 29 should be omitted.

Rule 76.—Reading should refer to Fig. 33A as well as Fig. 24.

Rule 78.—Change the words "bearing pieces" in the second line to "clamping pieces."

Rule 93.—Page 83, first line, change to ¼ inch by 6 inch.

Rule 94.—Change words "bearing piece" in sixth line to "clamping piece."

Rule 100.—Add "See rule 93 for sliding pieces and sliding irons."

Rule 101.—Omit.

Fig. 59.—Change cut to show 3 instead of 4 pairs of stakes to illustrate the rule rather than the exception.

Rule 81B.—Add words "structural bars and shapes" after "plates" in first line.

Fig. 46.—Change heading to read "Structural material loaded on flat cars or top of sides of gondola cars."

OVERHEAD INSPECTION OF BOX CARS.

The committee on rules for loading materials, to whom was last year assigned the formulation of rules for the overhead inspection of box cars for loading, was forced to present a report of progress at the last convention on account of its inability to satisfactorily cover the field a subject of so much importance seemed to warrant.

With the assistance of the American Railway Association, the General Managers' Association of the Southeast, and others, a great deal of data showing in a general way what was taking place, and what claims were resulting from damaged and defective equipment, were secured. However, the statistics submitted at that time and those subsequently obtained seem to be much the same, except perhaps in quantity, rate of increase, and losses sustained. In our previous report many of the various causes apparently responsible for damage to shipments were given in detail, covering no small space in the paper, hence such statistical information is regarded as needless at this time and has been omitted.

On account of the many damage claims presented, with the attendant difficulties in adjustment, often by reason of uncertainty in some instances as to the proportion of the claim that might belong to the condition of the car at the initial point of loading, and how much originated on the line of the road, its treatment, etc., it would seem proper to mention at the outset that the solution of the problem evidently narrows itself down to the important factor of inspection.

selection and proper preparation of the car at the loading station.

As was alluded to last year, it is the obvious precaution with which such an undertaking must be approached that further time was asked for, and, as anticipated, we find ourselves confronted with innumerable difficulties and objections offered by railroads explaining that latitude must be allowed on account of possible unwarranted interference to movement where unnecessary time might be consumed selecting and preparing equipment, especially where the supply and opportunity to obtain equipment is of considerable moment. It is still further argued that such a procedure might result in embarrassment if any specific and more stringent rules are established for the crating and inspection of equipment, even though the work be confined to cars for shipment of only certain commodities readily damaged by water, or leakage losses.

At all events, it seems to be the general opinion, at least in certain localities, that steps might be profitably taken working to the standardization of rules and requirements for the selection and inspection of equipment required for certain shipments, and it is the opinion of your committee that if it is going to be possible to secure improved conditions along this line, they are most likely to be obtained by confining our attention to shipments readily damaged by moisture, eliminating for the present the consideration of other commodities, at least until some systematic rule can be established and gotten under way.

It was with the idea that the best progress might be obtained by pursuing the lines of least resistance, your committee reached the conclusion that if it could, with the assistance of the American Railway and Master Car Builders' Associations, secure a complete list of the roads throughout the country using certificate of inspection cards, and obtain from them not only facsimiles of such cards used by them, but instructions going therewith, it might be possible to reduce the several forms to a composite card acceptable to all now using cards, and we would then have a card they would possibly be satisfied, in the interest of uniformity, to adopt in lieu of any standard they might now be using.

It has been the idea of the committee that this would seem to be the most profitable direction for their energies, and that a composite card acceptable to the roads now following the practice of securing certificate of inspection cards will be the first solid ground we might hope to reach towards working to a uniform practice. Furthermore, if the interest of such roads can be secured in this direction, the proposition will be readily given the necessary impetus to carry it as far as it can be employed with profit, and without danger of being used beyond the point of economy.

Working to this end, therefore, and setting aside for the present any consideration of the shipment of products other than those readily damaged by moisture, your committee has secured and shows herewith what is supposed to be a complete list of roads using certificate of inspection cards for the purpose above mentioned. As will be seen, they appear to be confined to the roads running out of Chicago, Minneapolis and St. Louis. The roads using such cards are as follows: Great Northern Ry.; Chicago, Burlington & Quincy R. R.; Chicago Great Western R. R.; Chicago, Milwaukee & St. Paul Ry.; Minneapolis, St. Paul and Sault Ste. Marie Ry.; Illinois Central R. R.; Atchison, Topeka & Santa Fe Ry.; St. Louis & San Francisco R. R.

As a matter of information and to show how deductions made by the committee have been reached, it presents herewith facsimiles of cards used by the above roads, with instructions covering their use.

The Great Northern, Chicago Great Western, and Chicago, Milwaukee & St. Paul use only one form of card and the card used by each road is practically the same. There have been no special instructions issued by these roads as to the inspection to be made, a specially trained man being selected for the work.

The C. B. & Q. uses four different forms of inspection cards. There are no specific instructions for inspection used. The master mechanics are instructed to have the empty cars inspected and carded according to their condition and the requirements of traffic.

The M., St. P. & S. S. M. are using two inspection cards, one for cars suitable for flour loading and one for cars not suitable for flour, grain or merchandise. The instructions relative to the use of these cards are that the cars are to be given a special interior and exterior inspection, to see that sheathing, lining, flooring, roofing, doors and fastenings are in good condition; any small holes found in the floor are to be cleated over, care being taken to bevel the edges of the cleats to prevent damage to flour sacks. Cars with a bad odor, due to carrying hides, oil, etc., are not to be used for flour. Cars otherwise O. K.'d, with the exception of having small oil spots on the floor, are to be painted over with quick-drying paint. All projecting nails, spikes or bolts to be removed or driven in to prevent damage to flour sacks, and all cars to be swept out thoroughly clean. Cars fit for flour loading are to be carded O. K., and the numbers and initial of such cars are to be turned in to the agent.

The Santa Fe are using two inspection cards, one for flour and one for grain loading. There is no difference in the make-up of the cards, except one is printed in red and the other in green.

The Santa Fe instructions relative to the use of the inspection cards are as follows:

"Where car inspectors are located, cards will be furnished the inspectors, and at stationsw here there are no car inspectors the local agents or their representatives will inspect all cars for grain and flour loading. If after proper inspection cars are found to be in suitable condition for grain and flour loading, a card is to be attached to the car door, three feet from the bottom of the door. Switchmen or local crews should be prohibited from placing at loading docks, platforms or elevators, an empty car which does not have one of these cards attached.

"When a car has been inspected and card placed thereon and placed at loading dock, and when shipper or his representative has inspected the car and accepted same for loading, the card will be detached and returned to the representative of the company, and shall be attached to and filed by the agent with duplicate bill of lading or shipping instructions.

"Shippers must be notified when a car is made empty at their plant that the car must not be loaded until it has been inspected and necessary card attached."

The Santa Fe are now contemplating the use of another form of inspection card, which is made up in manifest form so that shippers can have a copy for their use.

The Frisco Lines are using three forms of inspection cards.

As the result of an endeavor to fit together the cards now in use, the committee wishes to direct attention to some of the differences in their style; however, in the main they seem to have been designed for one and the same purpose. While the general practice seems to be to use cards bearing printing in large letters showing a specific commodity, or in some cases one or two products, we do not seem to be able to readily get away from a card on which provisions will be made for the designation of the shipment for which the car is inspected and made suitable without introducing more than one card, which was not wanted unless it cannot be avoided. A sample of such a card, representing the result of a combination of all the cards, with their instructions, would seem to be as follows:

A. B. & C. Ry.

This Car

No..... Initial.....

O. K. FOR SHIPMENT OF COMMODITIES.

Under.....Classification.

Inspected by.....

Date.....191.. Station.....

(Size of cards, 6 by 8 inches)

The committee wishes to point to the three apparent classifications of lading for which the box car is on some roads and in some localities receiving special attention before loading. The three classifications, as will hereinafter be referred to, would seem to cover the situation, at least until improvement can be suggested and worked out. The idea contemplates—

Classification "A."—Flour and Sugar.

Classification "B."—Bulk Grain.

Classification "C."—Lime, Cement Plaster; Boxed, Sack and Crated Packages of Seeds, Coffee and Merchandise; Hay, Dry Goods and Notions; high grades of finished Lumber; Tobacco, Furniture, Household Goods and certain grades of Tin and Galvanized Iron.

In the arrangement of the above classification, the items shown under "A," viz., flour and sugar, have been grouped together in order to secure cars which might be necessary for such shipments, i. e., those free from soiled floors and interiors carrying odors liable to damage the goods; whereas cars selected for Classification "B," intended for bulk grain, clearly indicate by their character what might be suitable for their safe transportation; likewise, Classification "C," covering the commodities mentioned, could be safely transported in a car which, while it should be tight, need not necessarily be as carefully selected as to other conditions as a car for Classification "A," intended for flour and sugar.

On back of cards, inspection instructions should be printed as follows:

INSPECT FOR		
Classification "A."	Classification "B."	Classification "C."
Leaky roof.	Leaky roofs.	Leaky roof.
Loose siding.	Loose siding.	Loose siding.
Loose roof boards.	Loose roof boards.	Loose roof boards.
Shifted roof sheets.	Shifted roof sheets.	Shifted roof sheets.
Broken door stops.	Broken door stops.	Broken door stops.
Leaky doors, tops and sides.	Leaky doors, tops and sides.	Leaky doors, tops and sides.
Broken end posts.	Broken end posts.	Broken end posts.
Broken or loose door posts.	Broken or loose door posts.	Broken or loose door posts.
Protruding nails in floor and lining.	Holes in floor and around center plates and draft bolts.	Protruding nails in floor and lining.
Floors soiled by oil, grease or any material carrying odors likely to damage lading.		

Method of Inspection Before Loading.

(A) Inspection to be made at point of loading wherever practicable.

(B) At point of distribution from which car is forwarded to loading station, and again by agent.

(C) Cars received and unloaded at station where no inspectors are located should be inspected by the agent.

Aside from the Master Car Builders' inspection of car, including roof, running boards, air brakes, safety appliances, and running gear, as well as the external inspection of sides, ends, doors, ventilators and windows, an internal inspection must be made of the roof and siding, with doors, ventilators and windows in closed position.

1. Search for light indicating openings and cracks which might produce leaks.

2. For loose, damaged and broken boards, loose knots, knotholes, bad joints, etc.

3. For all nails and bolts extending above surface of floor and lining and nails protruding through roofing.

4. Search for water stains indicating cracks and air spaces.

5. Search for cracks sufficient to admit storm water beating through opening, also for openings and bad joints around window and doors.

6. Examine for metal sheets out of position along edge of subcarlins or down from edge of ridge pole.

7. Search for small holes in metal roofs due to rust or small openings in roof from other causes.

8. Doors must open and closely properly.

The floors should be clean, dry and free from defects sufficient to admit moisture, and any fouling by previous shipments, such as fertilizer, oils and other freight which would damage more perishable commodities. If the centerpin is uncovered, it might be necessary to cover it with a piece of board, depending entirely upon the character of freight to be loaded.

Inspect closely for defects in framing which might, by reason of their weakness, allow the sheathing to be readily broken or damaged.

After a car is thoroughly inspected and known to be in good condition and suitable for the transportation of the commodities in Classification "A," "B" or "C," as the case may be, the inspector or agent, as provided for, making such inspection or able to certify to the condition of the car, must make out the prescribed certificate of inspection card and tack it to the car just under car number.

After the car is placed and accepted for loading, the certificate of inspection card must be detached from car and delivered to the agent before bill of lading is issued. The card must finally be attached to the agent's office copy of bill of lading or shipping ticket, for future reference in case of question arising as to the condition of car before loading.

Inspection of car bodies, doors, and the placarding of bad roofs, etc., as well as making notation of the extent of damage, is at present given attention; but it is also true that the general results seem to indicate that improvements can be made and higher efficiency obtained, since it seems to be generally accepted that any observation, inspection and amount of prevention can be more economically directed at the time of selection and preparation of the car than through repeated repairs and attention to cars en route, only to find car arriving at destination offering opportunities for criticism and possibly heavy damage claims. Hence the fact remains that the successful launching of any systematic and uniform practice hinges upon a closer inspection of equipment as to the physical condition of the superstructure for the loading of certain commodities, and such inspection should be made in the best possible manner, to meet local conditions.

Hoping that the committee has at least approximately succeeded in working out a composite certificate of inspection card which will be acceptable to the roads now employing such a practice of inspection, the committee would recommend that such roads be asked to use the card, or designate what might be done to make it acceptable, keeping in mind the desirability of reaching a uniform card. If this can be successfully obtained, it will give the association a standard card, and with the information gathered from them, other roads will be able to consider the card and use it if they so elect.

While it is very clearly understood that several roads, as above indicated, have used the certificate of inspection card with profit, and have succeeded in very materially reducing the damage to shipments and claims therefrom, other roads have indicated their lack of particular interest in any such move on account of either a vast difference in the variety of commodities handled or on account of the proportion of shipments not requiring such a careful inspection predominating; hence it would seem to remain with each road to work out and decide for itself what such a plan of inspection might net them.

It is certain, however, that the most earnest and sincere co-operation on the part of the railroads is absolutely necessary, otherwise the maximum benefit is not to be obtained for the amount of money thus expended.

The committee believes it perfectly feasible for all roads interested in the proposition to enter into the work of inspection along the line of that referred to, following not only the prescribed certificate of inspection card, but the instructions covering its use; and it is their belief that if the composite card, with instructions covering its use, is not satisfactory in all its details and in shape to be used on the roads now making use of such cards, very little work remains to make it uniform and satisfactory.

SUPPLEMENTARY REPORT.

When the report on the overhead inspection of box cars was sent to the secretary for printing, a copy was also forwarded to the eight railroads now using a certificate of inspection card, inviting from them criticism and suggestions as to what might be further offered in the committee's report. The real object, as explained to them, was to obtain their views upon the conclusions reached by the committee, and to further ascertain if, in their judgment, a uniform plan and the uniform card, as suggested by the committee, will meet the requirements; furthermore, if they would be willing in the interest of uniformity to use it in lieu of what might now be their practice.

Summing up the answers, therefore, it will be seen that the committee has failed to secure a unanimous approval of the inspection card recommended. While the majority of roads agree to the arrangement of the card, and the plan covering its use as suggested, others think that better results can be obtained by using separate cards for each classification; either printing on the card the commodity to be handled, or by using cards of different colors. The main objection raised against a single card for the three classifications is on account of requiring the inspector to write the letter "A," "B" or "C," indicating the classification; and there is still another objection raised, as it contemplates requiring the switchmen or trainmen to read the card and ascertain from the information written thereon the class of commodity the car is suitable for handling. The committee, endeavoring to make a complete review of the possibilities of determining what would seem to be required in the way of an inspection of equipment satisfactory for most of the commodities offered for shipment which might be readily damaged by moisture, found that a schedule for such an inspection was feasible, as has been shown in the report, and that the requirements can be made to very readily fit in with whatever final form and plan of handling the card is adopted; but has not been so successful in working out a card satisfactory to all railroads.

The use of colored cards would seem to be perfectly practicable, and would not necessarily disturb the fundamental inspection plan proposed, provided it would be considered better to relieve the inspection force from writing the classification "A," "B" and "C" on the card (which as a matter of fact is practically nothing); and requiring as a substitute the carrying of a larger number of cards so as to designate the classification by color.

It would seem to the committee that even such an arrangement could be worked out and still obtain a uniform practice; but it is the opinion of the committee that since it has gone about as far as it can in the consideration of this subject from a mechanical point of view, it would suggest that the subject be referred to the American Railway Association, or that a committee be instructed to handle it in conjunction with that association.

Committee: A. KEARNEY (Chairman), R. E. SMITH, L. H. TURNER, W. F. KIESEL, J. M. BARROWDALE, C. N. SWANSON, G. H. GILMAN.

Discussion.

F. F. Gaines (Cent. of Ga.)—It seems to me that the committee and association have carried the matter about as far as possible. I move that the matter be referred to American Railway Association and the committee continued to co-operate with it.

T. H. Goodnow (C. & N.-W.)—Is the proposed card supposed to carry any empties in the way of interchange, or simply intended for use by a road in selecting individual cars and forwarding them to train loading points?

C. N. Swanson—A card of this character is necessary in order that the cars be thoroughly inspected for the commodity for which they are intended.

T. H. Goodnow—I suggest that the committee consider this, as it is becoming more and more the practice to deliver cars already coopered, and it is difficult for a receiving road to make an inside inspection.

D. F. Crawford (Penn.)—I do not think we should send this to the American Railway Association at this time, as only eight roads are using these cards.

C. E. Fuller—I believe that few members present know much about the subject, and the committee's recommendation is about as far as this association can go.

I. S. Downing—I do not believe that we should try to inspect cars for a road three or four hundred miles away.

W. E. Dunham (C. & N.-W.)—We inspect the cars again when they are loaded, as that is the only way we can cut out improper cars.

C. E. Chambers—The condition of box cars today is deplorable, and the closer to the elevator the inspection is made, the better car you will get.

A. Kearney—In explanation I would say that this matter was handled by the American Railway Association, and they asked the Master Car Builders to work out a code of inspection rules.

F. F. Gaines—The managements are looking to us to do something, and I would say that it was the General Managers' Association of the Southeast that started this ball rolling.

I. S. Downing—Our assistant superintendent of motive power and myself inspected 27 box cars last week and we found 7 new cars unfit for grain. It cost considerable money to switch cars which are not fit for grain and to hold good cars for grain.

C. E. Chambers—That is the point I would like to know how many railroad men have control as to where their cars are going. The transportation department orders the cars where they want them.

J. J. Tatum (B. & O.)—There should be some standard method of inspecting cars for special lading. A man finds 50 cars fit. Then

there is a demand for more cars and the man is sent out to look for them, and he usually finds them. I think that it is wrong for one railroad to inspect cars and card them for another road.

Mr. Gaines' motion was carried.

CAR TRUCKS.

Design of Cast-Steel Truck Sides and Bolsters for Freight Cars.

A. Cast-steel Truck Sides.

The various designs of cast-steel truck sides were considered, but as a number of them are covered by letters patent it was decided to prepare diagrams showing the limiting dimensions for truck sides for 80,000, 100,000 and 140,000 pounds capacity cars, so as to provide for interchangeability of truck sides of the same capacities but different design, instead of proposing any definite design. The truck sides which come within these proposed limiting dimensions are to be subject to the specifications and tests contained in M. C. B. Recommended Practice adopted last year, which are being revised, and will include a proof load test for deflection without permanent set as well as limiting weights. This will provide truck sides which will be safe and interchangeable for the given capacities of cars for which they are intended and eliminates those of weaker designs.

The manufacturers have submitted drawings of the different truck sides manufactured by them, which are being tabulated with a view of arriving at the limiting dimensions. Results of tests of various truck sides made by individual railroads as well as manufacturers have been considered and tests are now being conducted by your committee, but the latter are not completed which prevents submitting definite recommendations to the Association this year.

B. Cast-Steel Truck Bolsters.

Tests of various types of cast-steel bolsters have been made and it is confidently expected that your committee will be able to recommend a standard design for Recommended Practice next year which will be applicable to truck sides represented by the contemplated limiting dimensions. It is intended to make provision for adjustable side bearings; and the question of center plates, whether they should be cast integral or be of the removable type, is receiving consideration.

The bolsters conforming to the design which will be proposed are to be subject to the specifications and tests contained in M. C. B. Recommended Practice adopted last year, which will be revised and also include a proof load test for deflection without permanent set, as well as limiting weights.

Limiting Strains Per Square Inch for Arch Bar Trucks.

It is the opinion of the committee that little would be accomplished in endeavoring to harmonize the different formulæ used for figuring the limiting strains for arch bar trucks, with a view of establishing a standard along these lines. The Association has adopted standard arch bars, column and journal box bolts for 80,000 and 100,000 pounds capacity cars. These standards are not being adhered to generally by the different railroads, changes being made in the truss dimensions to accommodate car construction and for design reasons. Different sections of arch bars are also used by some railroads on account of the standard section failing to meet the service conditions imposed. The committee is making a series of tests of the M. C. B. arch bar side frames, as well as of a number of individual designs, to determine their relative strength, and this data will be available for comparison with the tests of the cast-steel side frames when completed.

Axle Failures Under Tenders and Tendency of the Journals to Roll Out of the Bearing.

George R. Henderson, consulting engineer of the Baldwin Locomotive Works, raises two questions concerning the standard "C" and "D" axles, with 5 by 9 inch and 5½ by 10 inch journals, respectively, when used under tenders in connection with the operation of the quick-action E. T. brake under emergency application as follows:

1. Axle failures.
2. Tendency of the journal of the axle to roll out of the bearing or under the edge of the bearing.

In reply to the first question, the committee would refer to the report of the committee on Axles to the 1896 Convention, of which Mr. E. D. Nelson was chairman, which went into the calculations very

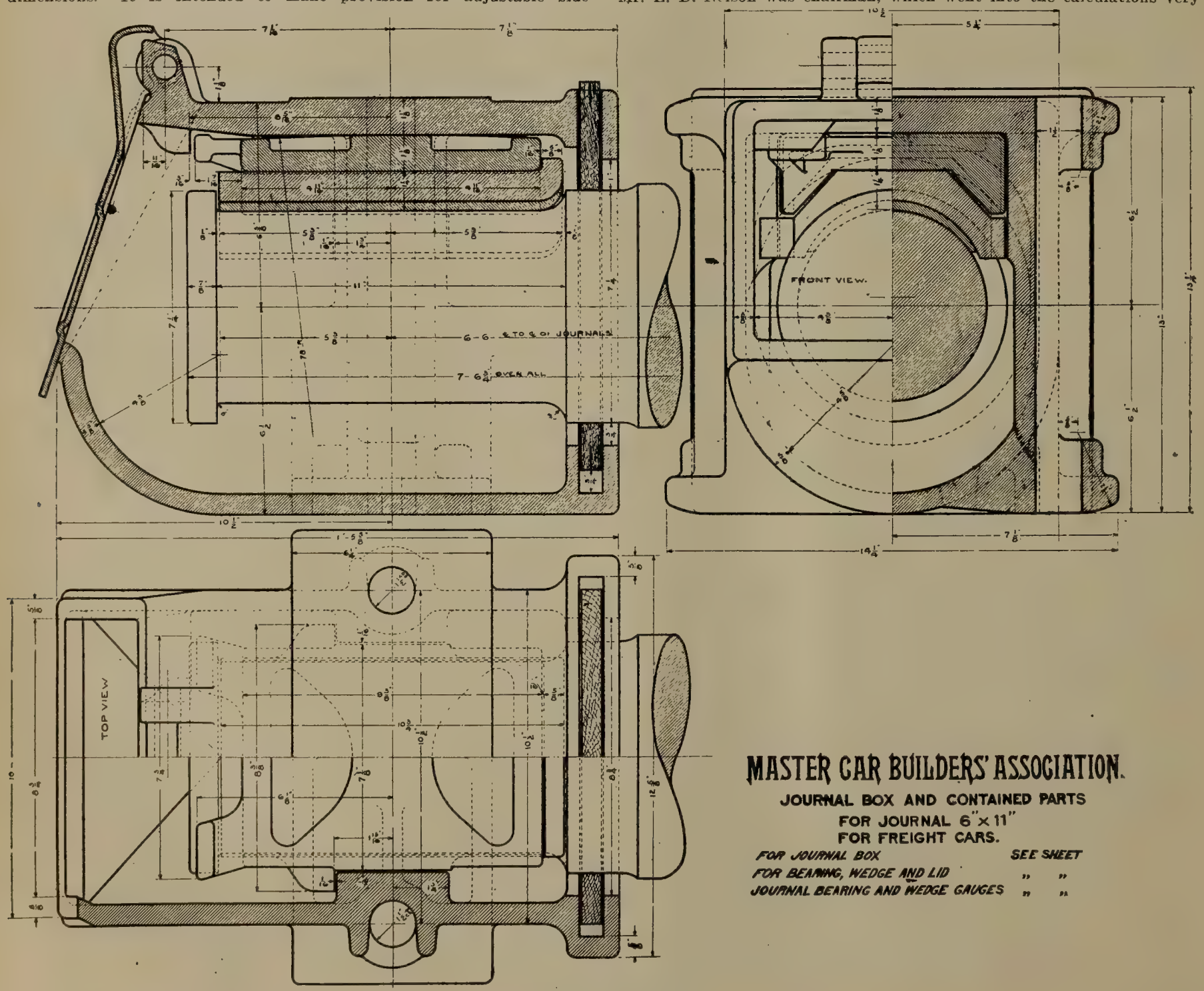
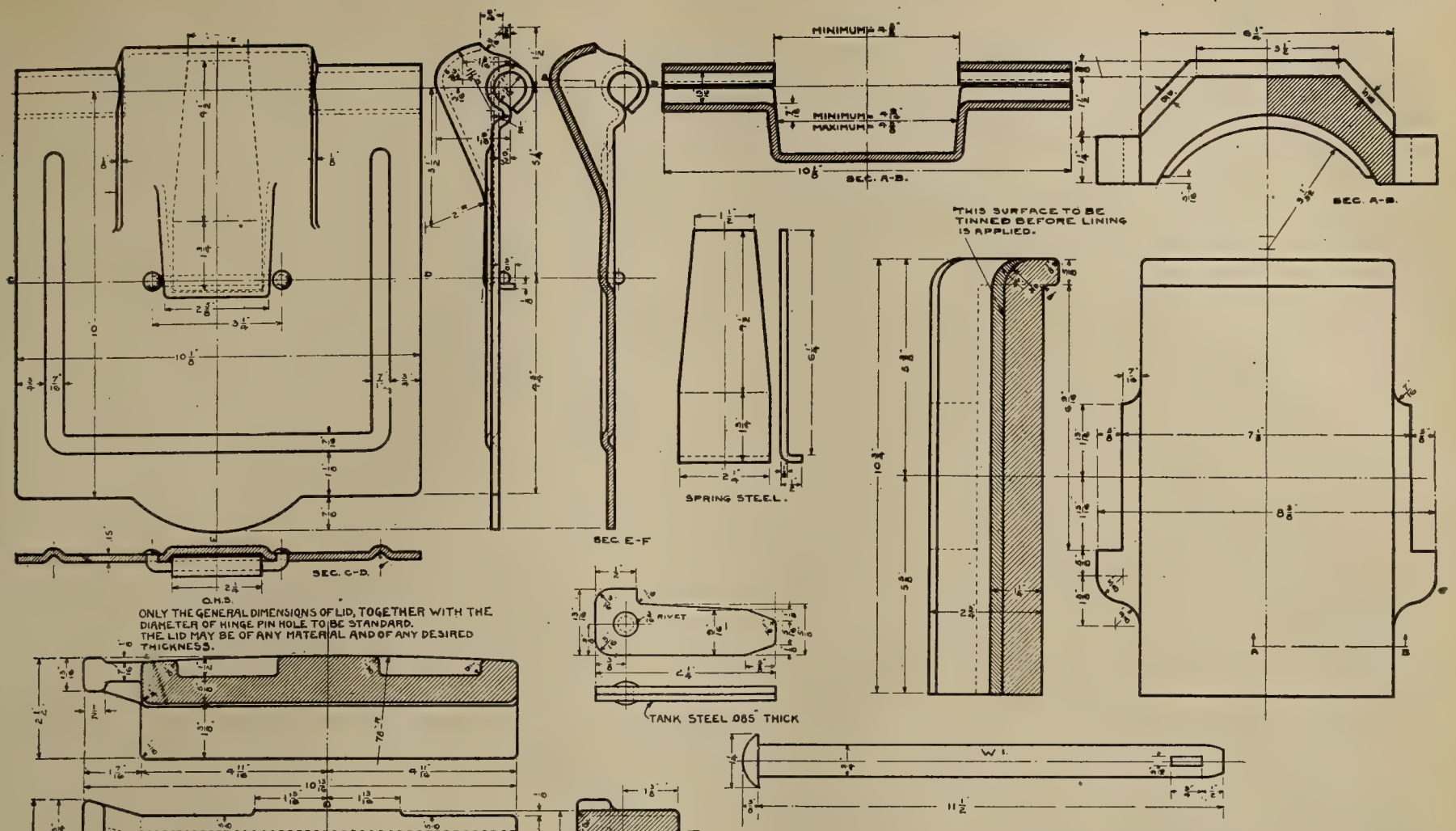

FRONT VIEW.
TOP VIEW
6 - 6 - 8 TO 8 OF JOURNALS
7 - 6 OVER ALL
MASTER CAR BUILDERS' ASSOCIATION.
JOURNAL BOX AND CONTAINED PARTS
FOR JOURNAL 6"×11"
FOR FREIGHT CARS.
FOR JOURNAL BOX SEE SHEET
FOR BEARING, WEDGE AND LID " "
JOURNAL BEARING AND WEDGE GAUGES " "

Exhibit A.


MINIMUM
MINIMUM
MAXIMUM
SEC. A-B.
SEC. A-B.
SEC. E-F
SEC. C-D.
SPRING STEEL.
THIS SURFACE TO BE TINNED BEFORE LINING IS APPLIED.
O.H.S.
ONLY THE GENERAL DIMENSIONS OF LID, TOGETHER WITH THE DIAMETER OF HINGE PIN HOLE TO BE STANDARD. THE LID MAY BE OF ANY MATERIAL AND OF ANY DESIRED THICKNESS.
RIVET
TANK STEEL .085" THICK
W.I.
SEC. A-B.

MASTER CAR-BUILDERS' ASSOCIATION.

JOURNAL BEARING, WEDGE AND LID FOR JOURNAL 6"×11"

THE LID SPRING MAY BE OF ANY DESIGN AND MAY BE SECURED TO THE LID BY ANY PRACTICABLE METHOD PROVIDED THAT IT WORKS PROPERLY ON THE STANDARD BOX AND IS OF THE DESIGNATED SECTION 2¼ x ⅛

A RIVET OR NUT MAY BE USED INSTEAD OF A COTTER IN HINGE PIN IF PREFERED.

Exhibit O.

thoroughly, using Reuleaux's method, graphical analysis, interpreting the same into mathematical formula. They selected a maximum stress of 22,000 pounds per square inch for the portion of the axle between the wheels, on the basis of calculation referred to above, according to which the M. C. B. axles are designed. The committee has not heard of any failures on these axles purchased according to specifications under the conditions mentioned by Mr. Henderson.

Referring to the tendency of the journal to roll out of the bearing, the committee would state that while it has no knowledge of this condition existing on tenders or freight cars, it was found on passenger cars equipped with standard M. C. B. bearings and high-hung single brake. Lowering the position of the brake shoe prevented the journal from rolling out from under the bearing. This tendency to roll out does not exist with clasp brakes. This subject was considered by the committee which conducted the Lake Shore Emergency Brake Tests, and their recommendations are recorded on page 89 of the 1910 M. C. B. Proceedings.

The committee would, however, be glad to be advised whether any of the members have experienced trouble of this kind under any of their equipment, and if so, under what conditions.

Springs.

The committee on Springs for Freight Car Trucks at the last convention submitted a tentative design of spring for 140,000 pounds capacity cars with arch bar trucks, recommending that the various railroad companies furnish dimensions of available space, or preferably prints of springs which have been designed or used for trucks with 6 by 11 inch axles. As far as has been ascertained, the Baltimore & Ohio and the Pennsylvania Railroad are the only roads who have placed such trucks in service.

The line of investigation thus far made covers the use of alloy steel springs. If alloy steel springs, which will stand about 35 per cent more stress when solid, can be furnished, it will be possible to adopt springs with sufficient flexibility for trucks having 5½ by 10 inch journals without any change whatever in the space now allotted for springs. For trucks having 6 by 11 inch journals it would then be advisable to use five springs, of exactly the same details as the four springs used for the 5½ by 10 inch journals, which will require the same height and about 40 per cent more width for spring space. It would then be advisable to make the bolster for the 140,000 pounds capacity truck somewhat wider, in order to avoid, to some extent, increasing the depth.

The committee, therefore, reports that progress has been made on the subject of springs, that experiments are under way which will not be completed until fall, and that it is expected to provide for five springs under each end of bolster for trucks with 6 by 11 inch journals, and from springs under each end of bolster for trucks with 5½ by 10 inch journals, each unit for the two types of trucks to be of the same design.

A. Construction of Center Plates for Standard Freight Cars.

This subject originated in a communication from Mr. W. J. Tollerton, general mechanical superintendent of the Rock Island Lines, in which he suggests for investigation "The construction of center plates for standard freight cars, bringing present practice as shown in the M. C. B. Proceedings up to date. Center plate shown is some ten years old and not suitable for steel-constructed cars."

According to the report of the M. C. B. committee on Side Bearings and Center Plates to the 1903 convention, the best results were obtained with a flat center plate having an area of 86,738 square inches, which resulted in the adoption of the present standard center plate with 100 square inches bearing area and is shown on Sheet M. C. B. 20 of the 1912 Proceedings. This centerplate has been generally adopted on 100,000 pounds capacity cars, and we have not heard of any serious objections to the same. This subject will be given further consideration by your committee in connection with the design of the standard truck details. It is desired that the members communicate to your committee any data showing wherein the present standard center plate has proven unsatisfactory, as well as any recommendations they may have to make.

B. The Distance of Side Bearings From Center Line on Various Capacity Cars, From 60,000 to 100,000 Pounds.

Mr. W. J. Tollerton suggests this subject for investigation. It will receive consideration in connection with the design of the standard bolster.

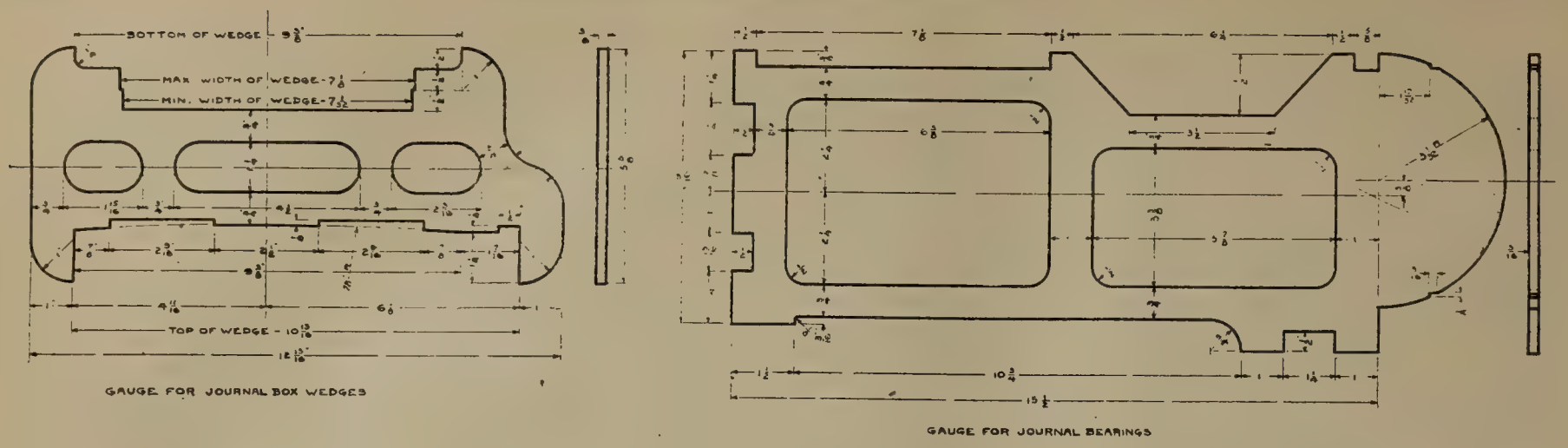

BOTTOM OF WEDGE - 9 3/8
MAX. WIDTH OF WEDGE - 7 1/8
MIN. WIDTH OF WEDGE - 7 1/32
TOP OF WEDGE - 10 13/16
12 13/16
GAUGE FOR JOURNAL BOX WEDGES
GAUGE FOR JOURNAL BEARINGS
STENCIL.
GAUGE TO DETERMINE THICKNESS OF METAL IN CROWN.
MASTER GAUGE FOR CROWN GAUGE
BOLTS.
FERROTYPE METAL SHEETS.

Exhibit D—Journal Bearing and Wedge Gauges for 6"x11" Journal.

C. Clearance of Side Bearings on 40 and 50-Foot Cars.

Mr. Tollerton also recommends this subject for consideration.

In the design of the standard truck bolster the committee will make provision for the adjustment of side bearings. The amount of clearance will also be set.

Journal Box, Bearing and Wedge for 6 by 11 Inch Axle Used in Freight Service.

Mr. D. F. Crawford, general superintendent motive power, Pennsylvania Lines west of Pittsburgh, recommends that standards be adopted for journal box, wedge and bearings for standard axle with 6 by 11 inch journal.

The committee presents the following and recommends that the same be submitted to letter ballot for adoption as Recommended Practice:

Exhibit "A."—Proposed Recommended Practice, journal box and contained parts for journal 6 by 11 inches.

Exhibit "B."—Proposed Recommended Practice, journal box for journal 6 by 11 inches.

Exhibit "C."—Proposed Recommended Practice, journal bearing, wedge and lid for journal 6 by 11 inches.

Exhibit "D."—Proposed Recommended Practice, journal bearing and wedge gauges for journal 6 by 11 inches.

Exhibit "E."—Proposed Recommended Practice, dust guard for journal box 6 by 11 inches.

NOTE.—Gauges for the 6 by 11 inch journal box are being designed and should be included in the letter ballot for adoption as Recommended Practice.

The standing committee on Brake Shoe and Brake Beam Equipment is offering in its report this year for Recommended Practice a design for No. 2 brake beam for use on freight cars weighing over 35,000 pounds. The adoption of this detail, as well as those covered in the program of the work of your committee, will enable the Association to have a standard freight-car truck.

Committee: J. T. WALLIS (Chairman), J. R. GOULD, J. J. TATUM, E. W. PRATT, R. W. BURNETT, JAMES COLEMAN, G. A. HANCOCK.

Discussion.

C. A. Schroyer (C. & N.-W.)—I do not agree with Mr. Henderson in as far as it has been the experience on our line. I am not in favor of the shape of wedge shown, insofar as the recesses on top are concerned.

E. A. Miller (B. & M.)—We have one of these on my road with the journal bearings split in two. It was not strong enough.

F. F. Gaines—I move that the committee be continued for another year and that the recommendations under article 6 be referred to letter ballot.

R. L. Kleine—I would like to know the cause of the split journal bearing which Mr. Millar speaks of. We have over a thousand cars running with these bearings and wedges, and have had no trouble whatever. It seems that there must have been some abnormal condition in this case.

E. A. Millar (B. & M.)—There was no abnormal condition and the journal had not run hot.

I. S. Dowing—We have had trouble with hot boxes on coal cars used on the dumping machine. In dumping the car upside down the waste gets under the bearing.

Mr. Gaines' motion was carried.

TRAIN LIGHTING.

The committee desires to make the following suggestions for Recommended Practices:

Axles for Axle Dynamos.

Axles for application of axle pulleys should be in accordance with these three designs: First, axle in accordance with M. C. B. standard, rough-turned; second, axle straight between the wheel-fit collars, rough-turned; and third, axle with straight pulley fit. In any of the above designs the axle pulley as recommended in paragraph 18 of recommended practices can be applied with the proper bushing.

The committee feels that the question of design of axles should be left to the mechanical men of the individual railroads in question.

Standard Design of Axle-Dynamo Suspensions.

Axle-dynamo suspensions must be designed so that with full diameter wheels and truck on straight, level track, any part of the dynamo or suspension must have a clearance not less than 6 inches above top of rail, and a clearance of at least 3½ inches between any part of the mechanism attached to the car body.

In axle-dynamo suspension the metal carrying the weight of the dynamo must not be subjected to wear.

In axle-dynamo suspensions, if side arms are used, the end to be secured to the truck frame must extend under transom and be bolted to the side frame near the transom, and if carried through or over end sill, must be held securely to end sill by a hooked bolt not less than ¾ inch in diameter.

When possible, the belt should go over the end sill and under the brake beam with belt clearances of at least 1 inch.

On account of the variety of trucks and car designs, it is impossible for the committee to recommend a standard suspension which will meet all conditions; the committee, therefore, recommended the design shown on Exhibit "B" where applicable, and in addition have inserted the general requirements in paragraphs 2, 3, 4 and 5, which, if adhered to, will eliminate the most objectionable features of suspension now in use.

Standard Design of Battery Box.

The inside clear dimension of battery boxes should be as follows:

Depth, front to back, 2 feet 4 inches.

Height in clear, not less than 21½ inches.

Length of compartment for two standard double-compartment tanks or equivalent, 22⅝ inches.

Length of compartment for four standard double-compartment tanks or equivalent, 3 feet 9¼ inches.

Battery boxes with two compartments each 22⅝ inches long, or with one compartment 3 feet 9¼ inches, must be designed to safely carry a battery weight of 1,600 pounds. Battery boxes with four compartments each 22⅝ inches long, or two compartments each 3 feet 9¼ inches long, must be designed to safely carry a battery weight of 3,200 pounds.

That in all battery-box designs, two angle irons or straps shall extend longitudinally under the battery box in such a location that in case of a defective battery-box floor the battery trays will be supported by the said angle irons or straps; the angle irons or straps shall be supported to the car body independent of the battery box proper and shall be of sufficient strength in all parts to safely support the battery

in accordance with the weight shown in paragraph 8 and the additional weight of the battery box proper, and the angle irons or straps and the supports for same shall be so installed that they can be readily inspected for corrosion.

On account of design of car underframing and the requirements of a different service, the committee finds it impossible to make detail specifications and dimensions for battery boxes which would be applicable for all conditions, and have therefore outlined general specifications as covered in paragraphs 7, 8, and 9, which will provide for proper strength of battery boxes and proper dimensions to allow of interchangeable equipment.

In the drawing on the height of battery box the minimum dimension is given instead of an exact dimension, as the committee felt that the maximum height of box obtainable should be used, but that the 21½-inch has been found to be the maximum height that can be applied on a number of roads on account of road clearances.

Recommended Practice as to Maintenance and Repairs of Batteries.

The following repair instructions were forwarded to the secretary, Mr. Joseph W. Taylor, to be referred to the Arbitration Committee for insertion in the Code of Rules:

"For repairs to electric lighting equipment on cars in interchange or leased cars, the instructions issued by the manufacturers of the apparatus should be strictly adhered to. In the absence of any agreement, the material furnished and applied must be of the manufacturer's make."

In the above the committee recommend that paragraphs 1, 2, 3, 4, 5 and 6, if approved as recommended practices, follow paragraph 19 in the present train lighting recommended practices under the caption of axle-dynamo, suspension. Paragraphs 7, 8 and 9, following paragraph 17 of train lighting recommended practices, under the caption of battery boxes.

In addition to the above, the committee makes the following recommendations:

Under the caption of axle dynamo, the following should be added to paragraph 18:

"Diameter of axle pulleys should preferably be 17 inches or 21 inches; the diameter of generator pulley should preferably be 8 inches or 11 inches."

M. C. B. Standard Sheet No. U-6 should be revised to show over-all dimension across the end of tank 10 inches.

Under the caption "Axle Dynamo," following paragraph 19, should be added the following:

"The electric connector between the dynamo leads and permanent wiring on the car should be made with non-reversing self-locking receptacle and plug."

Committee: T. R. Cook (Chairman), C. A. Brandt, Ward Barnum, D. J. Cartwright, E. W. Jansen, J. H. Davis, C. H. Quinn.

Discussion.

T. R. Cook (Penn.)—I move that the items be referred to the association for letter ballot.

TRAIN PIPE AND CONNECTIONS FOR STEAM HEAT.

PROPOSED SPECIFICATIONS FOR STEAM HEAT HOSE.

The committee finds that there is so little difference between the opening in the medium-size coupler and what is known as the large coupler that it does not affect the passage of steam through the train

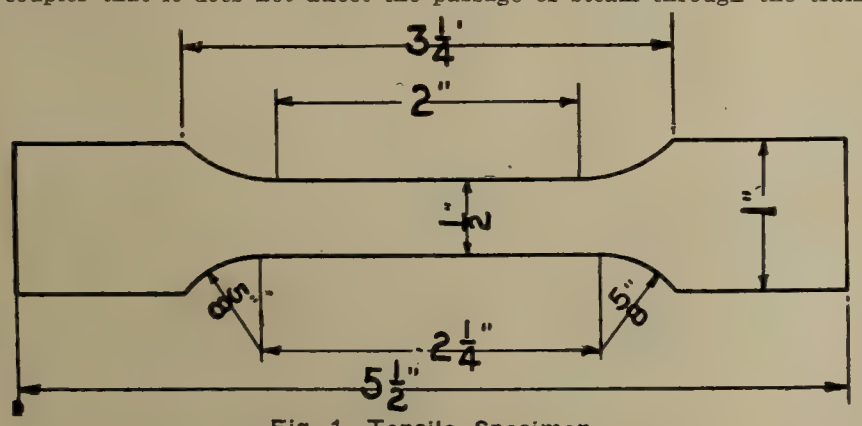


Fig. 1—Tensile Specimen.

line sufficient to warrant the large coupling and wishes to recommend the adoption of what is known as the medium-size coupling. It also wishes to recommend a two-piece coupler, with the nipple separate, and also a clamp which holds hose onto nipple by friction.

Proposed specification for steam-heat hose for passenger cars is shown below, and following this is a specification for steam-hose couplings. Inside diameter 1⅝ inches adopted as recommended practice in 1903.

Manufacture.

Steam-heat hose must be composed of a tube of rubber, wrapped with five-ply cotton fabric and the whole covered with rubber.

Physical Properties and Tests.

The railway company's inspector will select for test one piece at random from each lot of 201 pieces. When this hose is received at the test laboratory, a section 2½ inches long will be cut from one end in order to determine the friction, tensile strength and elongation. The remaining portion will then be subjected to steam heat in the digester.

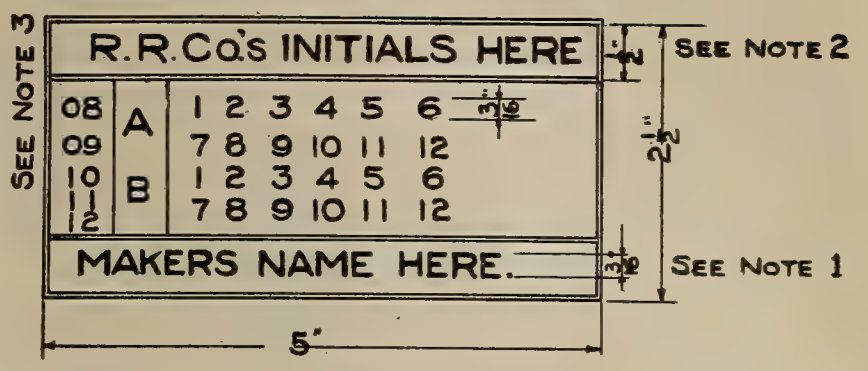

SEE NOTE 3
R.R.Co's INITIALS HERE
SEE NOTE 2
08
09
10
11
12
A
B
1 2 3 4 5 6
7 8 9 10 11 12
1 2 3 4 5 6
7 8 9 10 11 12
2½"
MAKERS NAME HERE.
SEE NOTE 1
5"
NOTE:—
No.1- MANUFACTURERS NAME TO BE PLACED IN THIS SPACE IN 3/16" LETTERS.
No.2- RAILROAD CO'S INITIALS WILL BE FURNISHED WITH INDIVIDUAL ORDERS.
No.3-THE FIRST FIGURE IS TO BE THE YEAR WHEN HOSE IS MADE. FOLLOWING FIGURES ARE TO BE SUCCESIVE YEARS.

Fig. 2.

After this section has been heated another section 2½ inches long will be cut from it and used to ascertain the friction, tensile strength and elongation, in order to show the change in these characteristics due to the action of heat.

Friction Test Before Steaming.—A section 1 inch long will be cut from the hose and supported in such a manner that it will turn freely on its axis. A twenty-pound weight will be suspended from the separated end of the fabric. The latter must unwind uniformly, if at all, and not faster than 6 inches in ten minutes.

Tensile Test Before Steaming.—A strip cut from the tube with a die or other suitable means to the dimensions shown in Fig. 1 will be marked at points 2 inches apart, and the width and thickness will be accurately measured. It will then be slowly stretched in a suitable tensile-testing machine until it breaks. The ultimate tensile strength must not be less than 600 pounds per square inch and the elongation of the 2-inch section at the time of fracture must not be less than 6 inches.

Friction Test After Steaming.—A section 1 inch long will be supported in such a manner that it will turn freely on its axis. A fifteen-pound weight will be suspended from the separated end of the fabric. The latter must unwind uniformly, if at all, and not faster than 6 inches in ten minutes.

Tensile Test After Steaming.—A strip cut from the tube with a die or other suitable means to the dimensions shown in Fig. 1 will be marked at points 2 inches apart, and the width and thickness will be accurately measured. It will then be slowly stretched in a suitable tensile-testing machine until it breaks. The ultimate tensile strength must not be less than 450 pounds per square inch, and the elongation of the 2-inch section at the time of fracture must not be more than 8 inches or less than 4 inches.

Size and Dimensions.

	Maximum, Inches.	Minimum, Inches.
Length	24¼	23¾
Inner diameter	....	....
Outer diameter	....	....
Thickness of tube	....	⅛
Thickness of cover	....	1/16

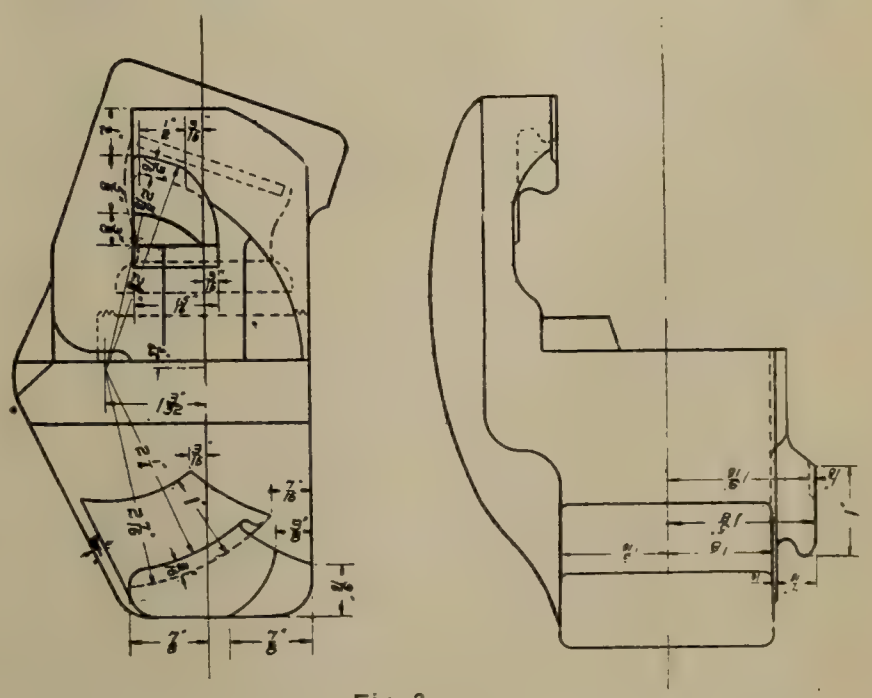


Fig. 3.

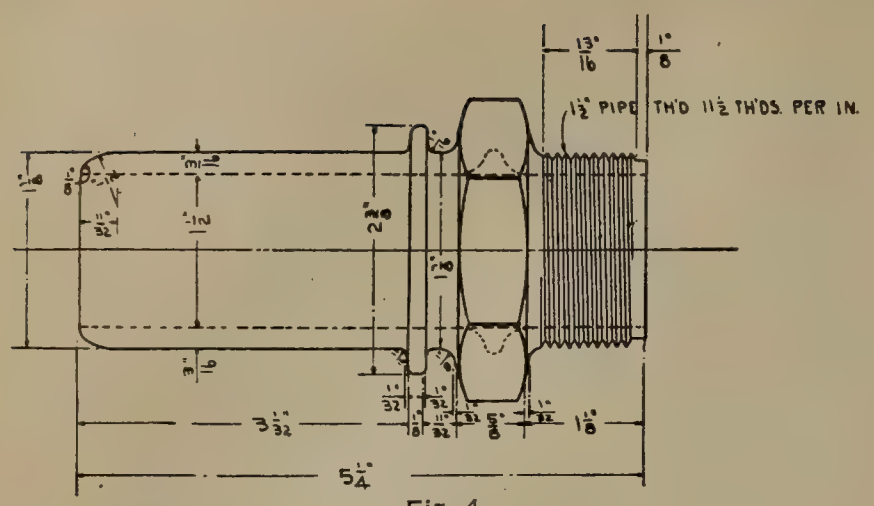


Fig. 4.

Workmanship.

Tube.—The tube should be composed of at least two calenders of rubber. It must be free from holes, bits of wood, bark, sand and other foreign matter, and from other imperfections. It must be so firmly joined to the fabric that it can not be pulled off without tearing it.

Fabric.—The fabric must be of duck, with the warp containing not less than 27 strands, 3 threads per strand, and the filler 18 strands and 4 threads per strand. It must be frictioned on both sides and have, in addition, a distinct layer of rubber on one side, readily visible between the plys when the finished hose is cut open.

Cover.—The material of the cover should be a rubber compound which has good weather-resisting qualities, as firmly attached to the fabric as is the tube, and to be equally free from defects. The end of the hose should be cut off true to length, but shall not be capped.

Marking.

Serial Number.—Each lot of 200 hose or less must bear the manufacturer's serial number, beginning with one on the first of each year and continuing consecutively until the end of the year. Serial numbers of hose which are rejected must not be used again. With each lot of 200 hose or less, one extra piece of hose must be furnished free of cost.

Label.—Each piece of hose must have securely vulcanized to it a label of white or red rubber, as shown on Fig. 2. The letters and figures in the badge plate must be $\frac{5}{16}$ inch high and 1/32 inch in relief, except in serial number, which must be ½ inch in height and 1/32 inch in relief.

Inspection.

Rejection.—If the sample fails to pass the above tests, the lot represented by it will be rejected, and the same serial number must not be applied to any other steam hose during the same calendar year.

Inspection.—If the sample passes all the tests, all pieces represented by it will be accepted if free from injurious mechanical defects.

Rejected hose will be returned at the expense of the manufacturer.

It will be noted in paragraph 3 (dimensions), that the committee has not recommended inner or outer diameter. The committee does not feel that the adoption of the specification need be delayed on account of this and it hopes the Association will approve of the committee's recommendations. If this is done, the committee has in mind the running of tests of hose made under these specifications, with inside diameter 1¾ inches with six-ply, 1⅝ inches with five-ply, 1½ inches with ends expanded five-ply.

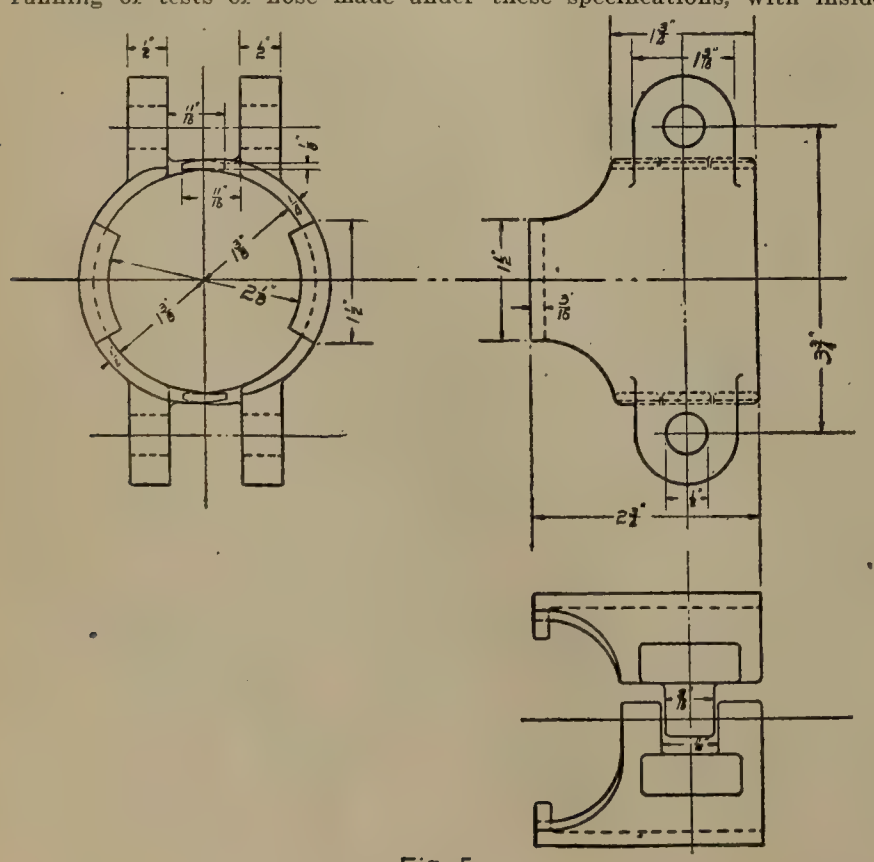


Fig. 5.

The committee recommends that these tests be conducted by the committee on Specifications for Air Hose and this committee be discharged.

Steam Hose Couplings.

Coupling contour to be such that coupling will interchange with the coupler as shown on Fig. 3.

Coupler must have a locking attachment which will securely lock the two couplers together without depending on the hose in any way.

The angle of the nipple to a line perpendicular to the coupling face of the coupling should not be less than 20 degrees.

The coupler should be of the two-piece type, having the nipple separate and screwed into the coupler head with 1½-inch pipe thread. The nipple shall be of the type having a shoulder to engage clamp-nipple shown on Fig. 4.

The clamp shall be of the two-piece type, as shown on Fig. 5.

The minimum diameter of hose through gasket to be $1\frac{7}{8}$ inches.

Gasket shall be flat face, securely held in place in coupler head, but so designed that they can be removed and replaced without removing hose or coupler head from car.

Discussion.

F. F. Gaines—We need to get down to a standard on steam hose and couplers. I move that the report be referred to letter ballot.

I. S. Downing—We did not give the inner and outer dimension of the hose, as some are using 1¾ inches, some 1½ inches and some 1⅝ inches. I would recommend that this be turned over to an air hose committee, and this committee discharged. The other committee can test out these three sizes.

C. A. Schroyer (C. & N.-W.)—If we adopt this as standard practice we will have the same trouble as we did with the air brake hose. If we go beyond a five-ply hose in the cold northern country it gets so cold that we can't do anything with them.

I. S. Downing—This does not affect matters until we get it into the M. C. B. Rules, but the specifications are a good thing for roads which don't have chemists.

C. A. Schroyer—The North-Western has always purchased 1¼ inch hose with expanded ends. After the nipple was changed we found we had to pay ¾ of a cent more for the larger hose.

Mr. Gaines' motion was carried.

TANK CARS.

Since the 1912 report, the Tank Car committee has approved, as meeting the requirements of the Master Car Builders' specifications for "Special" tank cars:

Design and specification for lagged tank car for the transportation of liquefied chlorin gas, submitted by the Goldschmidt Detinning Company, New York City. The design was shown by prints from tracings Nos. C-2258 GE, Tank Car; C-2258 G, Safety Valve, and C-2259 GR, Discharge Valve.

Design and specification for lagged tank car for the transportation of liquefied petroleum gas, submitted by the Pennsylvania Tank Car Company, Pittsburgh, Pa. Design shown by prints from Petroleum Iron Works Company's tracings Nos. 1317-A, 1317-B, 1317-C and 1317-D, 7750-Gallon Tank Car, General Drawing and Details. After this design had been approved the Pennsylvania Tank Car Company advised that before building cars in accordance with it they would like to go over the matter again with the committee, but so far they have not done so.

The committee also approved a design of cast-steel vent with frangible lead disk, for sulphuric acid tank cars, submitted by the Crescent Tank Line, New York City. Design shown by print from General Chemical Company's tracing No. 73 BZ.

The committee also considered the question of the handling in tank cars of bisulphide of carbon, which is highly inflammable, and gives off vapors under tension. As, however, the vapor tension came within the requirements for "Ordinary" tank cars, and as the Chief Inspector of the Bureau of Explosives saw no objection to the handling of this product in ordinary tank cars, the committee advised the Taylor Chemical Company, Penn Yan, N. Y., that there was nothing in the rules governing the transportation of materials in tank cars to prevent the handling of bisulphide of carbon in tank cars which meet the requirements of the M. C. B. specification for "Ordinary" tank cars.

The committee has still pending:

Design for tank car for casing head gasoline submitted by the German American Car Company, which has not been approved by the committee, pending revision of the drawings.

Also, question as to the use of existing tank cars for the transportation of ammonia solutions. In the case of this product it develops that the vapor tension at 100° F., may be as high as 22 pounds per square inch, and that the variation in the bursting pressure of lead disks nominally intended to rupture at 25 pounds is such that such a disk might rupture at 22 pounds. Consequently, after consultation with the Chief Inspector of the Bureau of Explosives, it has been decided that the lead disk should be made for a nominal bursting pressure of 30 pounds. This pressure would not in any way injure the tank, whereas the rupture of the disk would permit the loss of the most valuable constituent of the solution, viz., the ammonia gas. In view of the information that the life of tanks carrying ammonia

liquors is much shorter than that of petroleum carrying cars, the committee thinks it wise, for the present, to require retests at intervals of not over five years. These changes have been covered in the revision of the Tank Car Specifications.

As regards the tests of tanks and safety valves now provided for by the Tank Car Specifications, the committee feels that some improvement should be made on the present practice, by requiring that a certified record of the tests shall be available in some one office. Heretofore the rule has been that the railroad on whose line a car is at home shall exercise supervision. The importance of these tests will be very great in the event of lawsuits following damage, and your committee believes that the office of the Chief Inspector of the Bureau of Explosives would be the proper place for the filing of these certificates. Considering the fact that the Interstate Commerce Commission requires that tank cars shall conform to the rules of the Master Car Builders' Association, it is highly probable that a ruling will be made by the commission, fixing the procedure to be followed in reporting the tests of both cars and valves.

Nothing has transpired during the past year to call for any radical changes in the Tank Car Specifications. The changes which the committee recommends, which are detailed on the accompanying sheet, are principally with a view to removing ambiguities.

Committee: A. W. GIBBS (Chairman), C. E. CHAMBERS, S. K. DICKERSON, J. W. FOGG, E. J. SEARLES, WILLIAM SCHLAFGE, THOMAS BEAGHEN, JR., C. A. SHOEMAKER.

Discussion.

D. F. Crawford (Penn.)—I move that the recommendations of the committee be referred to letter ballot.

This motion was carried.

SPECIFICATIONS FOR FREIGHT CAR TRUCK SIDES AND FREIGHT CAR TRUCK BOLSTERS.

The committee on Specifications for Truck Sides and Truck Bolsters was appointed by the executive committee in 1911. In its first report, presented at the 1912 convention, it proposed for truck sides and bolsters specifications concerning the manufacture, chemical properties, physical properties and inspection of truck sides and bolsters. By subsequent action these specifications have been added to the recommended practice of the Association.

In its first report the committee also proposed tentative specifications for tests of truck sides and bolsters. It recommended that if the committee were continued, funds be provided for making tests, in order to develop information which could form the basis for final specifications for testing truck sides and bolsters. The executive committee of the Association has not found it feasible to provide funds for this work during the past year and the committee has, therefore, been unable to make progress along the lines originally laid down.

In the expectation that during the coming year funds may be made available to carry on this work, we recommend that the committee be continued.

Committee: EDWARD C. SCHMIDT (Chairman), J. S. SHEAFE, C. D. YOUNG.

This report was referred to the executive committee and the committee instructed to work with the committee on freight car trucks.

RETIREMENT FROM INTERCHANGE OF LIGHT CAPACITY CARS.

The question of the use of cars of 40,000 and 50,000 pounds capacity in interchange is one that is being considered very seriously in different parts of the country, and it has been suggested that it be taken up and discussed at the convention. I have therefore placed it on the program under the head of topical discussions, for consideration during the noon hour of the second day's session.

The suggestion is made that the subject be given a thorough airing at the convention, and if thought advisable, to take the matter up with a view to ascertaining whether it is practicable at this time to withdraw from interchange service all cars of 40,000 pounds and 50,000 pounds capacity, and restrict their use to the owning line.

It is the earnest request of the president that you be prepared to express your views when the question is reached on the regular program.

Jos. W. Taylor, Secretary.

C. E. Fuller (U. P.)—This is an important subject and these cars should be objected to in heavy freight trains.

F. W. Brazier (N. Y. C. & H. R.)—I move that after January 1, 1915, cars of 50,000 pounds capacity and under will not be accepted in interchange unless equipped with steel underframe and all metal trucks.

C. F. Giles (L. & N.)—This will not affect us except with reference to refrigerator cars. We have a large number of comparatively new refrigerator cars of 50,000 pounds capacity.

J. J. Hennessey (C., M. & St. P.)—I think it hardly correct to bar cars of any capacity. Some of the 50,000 pounds capacity are better capable for switching than the 60,000 and 80,000-pound and many of the 50,000-pound have better draft timbers.

D. R. MacBain (L. S. & M. S.)—The New York Central seldom operates over 50 per cent of its own equipment on its own lines, hence the chance for failure is great. A report of draft gear and draw bar failures I received some time ago showed that 47.6 per cent of the cars on the Lake Shore were foreign and that 73.8 per cent of the draw bar failures occurred on this equipment. Now, if July 1, 1915, is too short, we, of course, can extend the time.

F. F. Gaines (Central of Ga.)—Our experience is that the light capacity car is not in line with other cars.

R. E. Smith (A. C. L.)—Has this Association the authority to pass resolutions offered? We have a number of low capacity cars (about 40,000 pounds) and we are making considerable improvements in them.

C. A. Scroyer (C. & N.-W.)—I question as to whether we can say that on a certain day we will not accept certain cars. It might be well for us to recommend to our superior officers.

D. F. Crawford (Penn.)—Since 1904 I have had a monthly report of truck accidents, and have found that 80 per cent of them occur on foreign lines. I think that this is the proper association to bring this up, but not to carry it out. I move that the committee obtain the views of the roads with a view of conferring with the American Railway Association.

I. S. Downing (L. S. & M. S.)—I believe that the 50,000 pound capacity cars which are not being properly maintained should be taken out of service.

M. K. Barnum—I do not think that we are justified in keeping up these cars beyond their normal life. A large percentage of bad order cars have been of this class, and they have been the principal cause of the increased cost of freight cars.

H. J. Small—We people out on the coast are the chief victims and we find it a hard job to repair cars so that we can get them back east, for after they have traveled over the mountain grades they are in pretty bad shape.

J. J. Tatum (B. & O.)—The B. & O. has very few light cars. As I understand Mr. Brazier's motion, cars could be accepted if equipped with steel underframes and metal trucks. The B. & O. expects to apply 5,000 underframes this year.

D. F. Crawford—We would be just as far along by having a committee investigate this subject and after January 1, 1915, something should happen.

Mr. Crawford's motion was carried.

CAPACITY MARKING OF FREIGHT CARS.

The committee sent out to the members the following Circular of Inquiry:

"The committee, appointed to look into and report on the subject of capacity marking of freight cars, having summarized the replies to M. C. B. Circular No. 25, Capacity Marking of Freight Cars, notes under heading (d) five replies, 209,153 cars, against stenciling cars with their light weight and maximum weight, for the reason that it has not been demonstrated that this practice might not be applied to cars the body or trucks of which are structurally weak and which are at present stenciled to carry the maximum load to which they should be subjected.

"In view of the above, we believe it urgent for each individual car owner belonging to the Association to investigate and advise:

"1. Whether your company now owns or operates, or whether you know of any equipment the body or trucks of which are structurally weak. If so, give number and class of such cars."

The committee sent out a circular letter of inquiry and to this circular the committee received 35 replies, representing 924 votes. A careful analysis of these replies is as follows:

"Whether your company now owns or operates, or whether you know of any equipment the body or trucks of which are structurally weak. If so, give number and class of cars."

In answer to this question 16 lines, representing 322 votes, report owning or knowing of weak cars or cars that would prove structurally weak if loaded to full axle capacity. These cars are for the most part wooden cars in coal trade, which would not permit the "Maximum Capacity" stenciling.

Fourteen lines, representing 349 votes, do not own or know of any cars that are structurally weak. Five roads did not vote directly on this question.

"Whether your company owns or operates any cars the body or trucks of which are strong enough under the present stenciled capacity, but which would not be strong enough under the proposed light-weight and maximum-weight stenciling. If so, give number and class of such cars."

The majority of the roads vote in the affirmative in answer to this question. Out of the 924 votes, 662 report owning certain cars that are not strong enough and to which it would not be advisable to apply the "Maximum Capacity" plan of stenciling. While there does not seem to be any doubt, as a rule, regarding the structural strength of the modern car, and its ability to carry the increased load permitted by the "Maximum Capacity" plan of stenciling, 23 roads report certain types of structurally weak cars, such as flat, gondola, and wooden-underframe cars, which would develop higher stresses under the maximum loading than would be proper or permissible.

"Whether there can be any objection in applying the rule of light-weight and maximum-weight stenciling so far as it is applicable, consistent with strength of body or trucks which are not structurally weak, thereby restricting the stenciling of cars where the body or trucks may be structurally weak to the present light-weight nominal capacity."

Twenty-seven lines of the 35 who voted, or 75 per cent of the total

cars represented by the votes, are in favor of stenciling the maximum-weight capacity on cars whose strength will permit it. Two companies did not vote on this question, and the other 6 are opposed to it on the grounds of the confusion to shippers, etc.

While the majority of the votes cast are in favor of limiting the proposed stenciling to cars that are strong enough, the question has naturally arisen as to what cars are strong enough, and how this strength should be calculated—that is, by the individual car owner or by a standard adopted by the Association.

"Whether or not it would be more advisable to apply the rule of light-weight and maximum-weight stenciling to steel and steel-underframe cars exclusively, and moreover to such cars of this class as have a factor of safety sufficient to carry the maximum load; also, in the opinion of the members, what the minimum factor of safety should be for maximum loading, stenciling."

Of the 924 votes represented, 443 (12 roads) are in favor of confining the "maximum weight" method of stenciling to steel and steel-underframe cars, 2 lines did not vote directly on the question, and 463 votes (21 roads) do not approve of this plan; some on the grounds that it should apply to all classes of cars whose strength would permit it, others on the ground of confusion to shippers, etc.

Relative to minimum factor of safety, only 11 companies expressed an opinion:

Four companies suggest a maximum fiber stress of 16,000 pounds per square inch in body structure.

One company suggests a maximum fiber stress of 12,500 pounds per square inch in body structure with a partially distributed load, and for a buffing shock of 300,000 pounds when car is empty or loaded.

One company suggests that the factor of safety should be at least 8 in any portion of the arch bars.

One company suggests on trucks a factor of safety of 15 on parts in compression, a factor of safety of 10 on parts in tension, and a factor of safety of not less than 5 in the rest of the structure of car.

Two roads recommend a factor of safety of 3 for steel and steel-underframe cars.

One road is in favor of a factor of safety of 5, and one road suggests that the factor of safety should be variable for different classes of equipment.

In line with the limited views expressed as to factors of safety, we feel that the light-weight and maximum-load stenciling should be confined to cars of steel or having steel underframes that have a factor of safety of 3 or better in the body structure, when figured for the maximum load, and with respect to trucks under such cars, the rule should be applied to all trucks having arch bars of M. C. B. dimensions or better, and to all trucks having cast-steel side frames, and to the various forms of special trucks such as pedestal type trucks of the box and other varieties, where the strength of factor of safety is equal to or greater than the equivalent M. C. B. arch bar.

On new cars the committee feels that the rule should be applied in its entirety, owning to the fact that practically all new cars are steel or steel-underframe construction, and will in all probability be built to meet the proposed requirements of 24-inch minimum cross-sectional area of center sills recently proposed by the committee on Car Construction to take care of buffing shocks, which imposes a construction which we feel will result in a high factor of safety on underframes from a load standpoint. With relation to trucks under new cars, the rule should be applied only when such trucks meet M. C. B. requirements or better as to arch-bar construction, or have steel side frames, or have pedestal type trucks where the factor of safety is equal to or greater than the equivalent M. C. B. arch bar.

Pending further investigation on the part of the committee, we would endorse the recommendation of a member that the subject of stenciling the light weight and maximum load be referred to the American Railway Association in order to ascertain whether there are operating or traffic conditions with which the proposed method of stenciling would interfere.

Committee: C. E. Fuller (Chairman), M. K. Barnum, A. W. Gibbs, F. H. Clark, D. R. MacBain.

Discussion.

D. R. MacBain (L. S. & M. S.)—There is considerable trouble in billing freight in private line cars, as these companies do not follow the M. C. B. practice of stenciling. Also these companies do not publish the data regarding their cars in the Railway Equipment Register.

M. K. Barnum—I move that the subject be referred to a letter ballot to obtain the views of the members and then referred to the American Railway Association.

This motion was carried.

LETTERING CARS.

(The first portion of this report is devoted to an outline of work which had been previously done on this subject.)

At the meeting of the executive committee of the M. C. B. Association in the office of the secretary, August 13 and 14, 1912, the present committee on Lettering of Cars was continued another year, and to this committee was referred a copy of the proceedings of the American Association of Railroad Superintendents, meeting held September 9, 1910, the subject of car lettering being covered on pages 175 to 179.

Subsequent to this, correspondence was carried on between D. F. Crawford and J. A. Sommerville, then president of the American Association of Railroad Superintendents, at Kansas City, regarding the lettering of cars.

This correspondence resulted in the appointment of Charles Burlingame, superintendent of the Wiggins Ferry Company, St. Louis, Mo., to represent the members of the Association of Superintendents and meet the committee of the M. C. B. Association and consider the matter further.

After some subsequent correspondence between Mr. Crawford and Mr. Burlingame, a subcommittee was appointed to investigate the matter and to meet with the Superintendents' Association of St. Louis and ascertain just what further changes and additions were desired. Mr. Burlingame appointed M. Marea, general superintendent of the St. Louis, Troy & Eastern Railroad to represent the Superintendents' Association, while the following subcommittee was appointed to represent the M. C. B. Association:

W. L. Wilt, Penna. Lines (Chairman); C. B. Young, C., B. & Q. R. R.; O. C. Cromwell, B. & O. R. R.; Ray M. Brown, New York Central Lines

The subcommittee met with the Superintendents' Association of St. Louis in February last, with the view of ascertaining what their wishes were, and found that all they request was that we have separate letters placed on each side of the car, near the door hasp, for seal record purposes, so that such records could be taken by letters instead of using the words north and south or east and west with reference to sides of cars, as at present, they claimed, on account of cars going across the ferry at St. Louis and the switching of cars in congested districts, they are turned on Y's, destroying their seal records. This they feel is necessary on account of the large amount of pilfering going on in the St. Louis district. These letters were to be placed on the cars with respect to the A and B ends, using the letters R and L, or any other letters, to signify the side.

The subcommittee does not recommend the application of the additional lettering, but on account of the fact that this marking is entirely for the benefit of the operating department, it is suggested by your committee that a special letter ballot be taken to ascertain the views of all members of the Association.

Committee: D. F. Crawford (Chairman), F. H. Clark, F. A. Torrey, D. R. MacBain.

Discussion.

D. R. MacBain—I move that the recommendations of the committee be submitted to letter ballot.

This motion was carried.

D. F. Crawford (Penn.)—I move that we be permitted to use a badge plate with smaller letters on cars with steel outside frames, and that the subject be referred to the proper committee.

This motion was carried.

WEDNESDAY, JUNE 18.

DAMAGE TO FREIGHT CAR EQUIPMENT BY UNLOADING MACHINES.

The committee, instructed to look into the damage to freight equipment cars by dumping or unloading machines, finds that considerable has been done along this line, not only by the Pennsylvania and Lake Shore & Michigan Southern, as reported last year by the standing committee on Rules for Loading Material, but in addition by the Baltimore & Ohio, Wheeling & Lake Erie, Hocking Valley, Toledo & Ohio Central, and others.

There are two types of car dumpers in use. One in which the track or platen on which the car rests is moved transversely, bringing the side of car against the side of cradle, and which will be referred to in this report as movable-platen type. The other is that in which the track is built solid with the cradle, and cradle side is moved in against car side by means of hydraulic cylinders, and will be referred to in this report as solid-floor type.

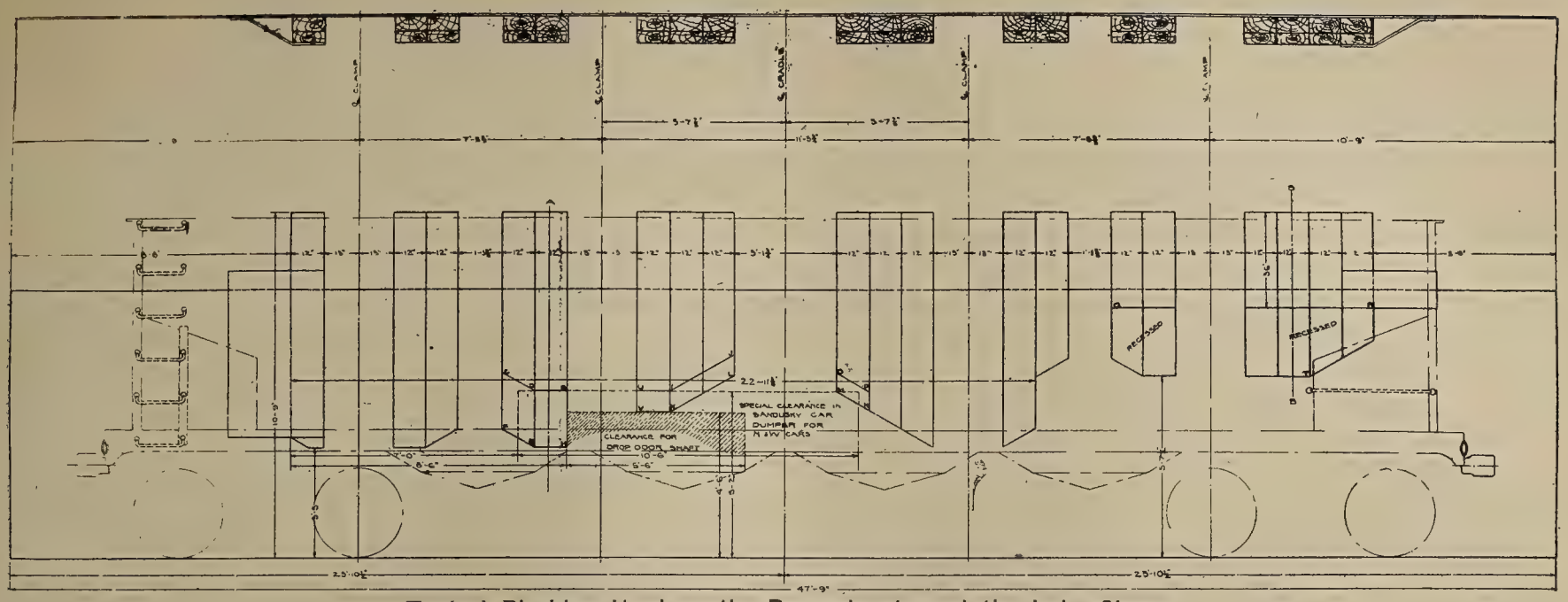
Movable-Platen Type.

The supporting track on platen has its center coincident with that of the supply track leading to machine, when cradle is at its bottom or normal position, this being controlled by cams underneath the platen. When cradle is raised the cams become disengaged and chains which are attached to platen, and which pass through hollow clamps and extension clamps to counterweights, move the platen transversely, bringing car against side of cradle. As the cradle continues to raise, the hook clamps, which move by their own weight in guides, bear on the top of car and hold car to platen by the combined weight of the clamps. When the cradle rotates to dump the car the extension clamps are brought over the top of car.

Solid-Floor Type.

The sequence of clamp operations can be varied, as the movement of hydraulic pistons is controlled by independent valves. When car is placed on supporting track the pistons are all in release position. The cradle side is first moved in against top of car by a piston, bringing clamp over car side and outside. Another clamp is brought over car side by a piston. Both clamps are next brought down on top of car by piston. Buffer is then brought out against car by piston, thus making all clamps in operation, and cradle is then rotated about its center.

With machines of movable-platen type the damage occurs when the cradle of car dumper is rotated, due to their not having proper bear-



Typical Blocking Used on the Pennsylvania and the Lake Shore.

ing against the side of cradle, the side of car coming in contact with the clamp housings or side of cradle, and damaging or destroying side ladders, hand-holds, roping staples or door-operating mechanism, and by the absence of extension clamps.

With machines of the solid floor type the damage is done by hydraulic-operated clamps crushing in sides of car and bending down top of car, and I beam of floor system outside of rail being too high and striking column bolts.

To prevent the damage to cars, the cradle on both types of dumpers should be faced with timber, preferably 10 inches thick, on specified areas and with openings between said timbers. The timbers are provided for car to rest against when rolled on its side, and the openings are to permit of contents that have fallen into cradle being dumped on the next turn of the cradle. The blocking is so arranged to protect the extending appliances by providing for them in areas not covered with blocking. On the machines of solid-floor type the method of moving cradle side will have to be changed so that the side pressure on car will not be greater than the combined weight of the heaviest car and its contents, and so that the vertical clamping will not exert a pressure on top of car greater than that now used on movable-platen type.

The principal features to be considered in providing the protection for both types of machines are, therefore:

First: Provide as much bearing as possible on cradle side for car and at the same time insure ample clearance for safety appliances and other attachments projecting beyond side stakes of car.

Second: Allow for sufficient variation for spotting cars in cradle, so that time will not be lost in placing cars, with a resulting decrease in the capacity of car dumper. The protection should be so placed that when a car is stopped anywhere within 2 feet said blocking will be ample to support car on its side. A greater allowance than 2 feet is to be preferred when it can be provided without making a supporting area so small that car will be damaged.

Third: Provide blocking so that the bearing face can be quickly renewed, so that it may be maintained in proper condition at all times by applying same when machine is idle, to avoid necessity of shutting down dumper to apply blocking.

Fourth: Provide guide plate at in-bound end of cradle for entering cars with spread sides.

Fifth: Machine to be provided with not less than four vertical clamps, and each of these to be equipped with extension clamp.

Sixth: Grade of yard track leading into cradle to be of 100 feet radius, to prevent damage to carry irons when cars are moved into machines coupled.

Seventh: Timber lining to be cut at angle at lower ends to permit contents spilled into cradle to get out on next turn of cradle.

Features to be considered in addition to the above, but only on solid-floor type machines, are:

Eighth: No side pressure to be used which will force car against lining in cradle with a pressure greater than the combined weight of car and contents.

Ninth: Vertical clamps to be operated by gravity so that pressure on top of car will not exceed that now used in movable-platen type machines.

Tenth: Top of I beam in floor system and just outside rail to be made same height as rail.

With the foregoing conditions to meet, the committee finds that to provide a lining or blocking for gondola and hopper cars owned by all railroads, could only result in insufficient support for a great many cars. It is therefore necessary for each railroad to make a study of the cars handled by machines on their lines and apply blocking according to the foregoing principles laid down, and as per typical example below in the figure. The modifications for the solid-floor type alone, as given in eighth, ninth and tenth items, will have to be provided for by the machine designers.

The figure shows a typical blocking used by the Pennsylvania and Lake Shore & Michigan Southern on machines of the movcable-platen type, and the committee would call attention to the additional clearance necessary in the Sandusky car dumper to prevent damage to the side wheel operated cars of the Norfolk & Western Railway. If it were not necessary to provide this clearance in this particular machine, a greater bearing could be given cars by cutting the blocking along the lines F G H instead of C D E, along V K L instead of U I J, and along M N instead of O P. Furthermore, the recessed portion below line Q R is for existing vertical handholds, and which surface can be brought out full with the balance of the blocking down to line S T and after July 1, 1916, when vertical handholds are no longer permissible, for all horizontal handholds will then pass below the line S T.

In connection with the foregoing, the committee desires to call attention to the following, and the necessity of each railroad giving same the proper consideration in connection with car dumpers operated by it and by plants along its line.

Composite drawings of all cars to be handled by machines should be prepared and drawings for the blocking furnished to contractor when machine is purchased, in order that he may provide necessary blocking, means of securing same, and reinforcement back of cradle to support the weight of car when on its side.

When designing new cars, that some thought be given as to its use on car-dumping machines.

The providing of protection in accordance with this report should be taken up with plants operating car dumpers along the line of railroad, as much damage is done at steel and other manufacturing plants.

When applying this blocking to existing machines, the back of cradle wall or side should be reinforced to prevent bulging and making useless the blocking.

Extension clamps through which chains pass must be used at all times to prevent damage to car sides by chains. Face plates must not be used on face of timbers, as cars will slip on metal-plated blocking.

This report has been made covering car-dumping machines. There are other machines and appliances used in loading and unloading cars which require additional study.

Regarding recommendations for suitable wrench for opening hopper-bottom cars, and uniform size of shafts under these cars, your committee finds that in order to fully cover this subject it is necessary to collect and consider all forms of operating mechanism for hopper-bottom cars, but has not to date been able to get this information, and would therefore ask for further time.

Committee: P. F. Smith, Jr. (Chairman), J. J. Tatum, E. A. Westcott, I. S. Downing, J. J. Birch, C. S. Morse.

Discussion.

J. J. Tatum (B. & O.)—This report should be given thorough attention by the individual railroads and I am surprised at the lack of attention which has been shown by the roads.

D. F. Crawford—Are the diagrams and recommendations in shape to be submitted to letter ballot for adoption as recommended practice?

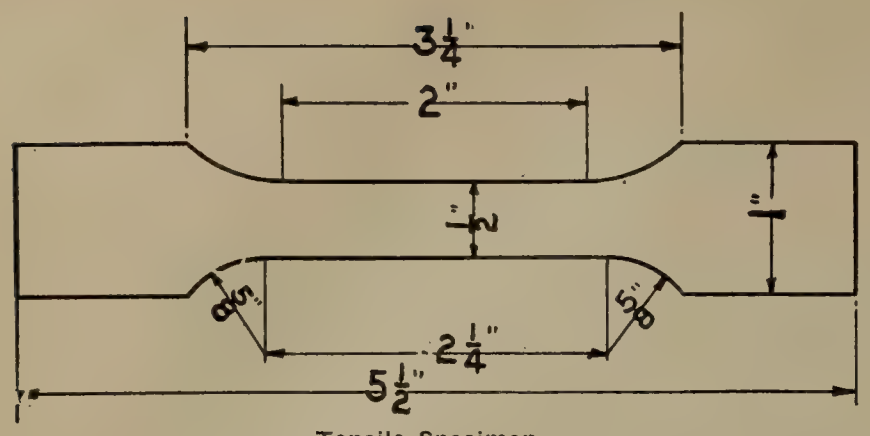
J. J. Tatum—The recommendations are in such shape.

D. F. Crawford—I move that they be prepared for submission to letter ballot.

This motion was carried.

AIR BRAKE HOSE SPECIFICATIONS.

Tentative specification was drawn up at a meeting held April 3 and at the next meeting, to which rubber manufacturers had been invited to send representatives, twelve responding, on April 4, each proposed requirement or change was jointly discussed. One of the items discussed by the committee was that of labels for air hose. The inspec-



Tensile Specimen.

tion of any pile of scrap hose will indicate that the calendar, from which is supposed to be cut the date of application and removal of the hose, is seldom used. It is, therefore, evident that the ends for which this label was designed are not being lived up to, and that its usefulness is questionable.

The addition of a second label, which is supposed to indicate to car inspectors, without the necessity for their going between cars, that such hose is M. C. B. standard, means considerable extra and unnecessary expense.

In the opinion of the committee, both the present labels should be discontinued, and in place of them the following design is recommended:

This label should be applied around the hose within 6 inches of one end.

In mounting the air hose, coupling is applied to the end near which this label is located, so that the drawbar will not obscure the same when an inspector is on the right forward or left back side of a car.

As this label contains all necessary information, and as the life of a hose can be exactly known from the date of manufacture shown, it is recommended that this question receive the most careful consideration of each member voting.

Following is the specification which the committee feels will accomplish a vast deal in the improvement of air-brake hose.

There is some good reason for each requirement, and the committee has had constantly in view a high-grade air-brake hose, with due consideration of commercial practicability.

PROPOSED REVISION OF SPECIFICATION FOR AIR-BRAKE AND SIGNAL HOSE.

Adopted as Recommended Practice in 1901. Advanced to Standard in 1903. Revised 1905. In 1911, detail specifications of label were placed under the heading "Label for Air-Brake Hose."

MANUFACTURE.

All air-brake hose shall be soft and pliable, and not less than four-ply. They shall be made of rubber and cotton fabric, each of the best of its kind for the purpose. No rubber substitutes or short-fiber cotton to be used.

PHYSICAL PROPERTIES AND TESTS.

Hose will be subjected to the following tests:

Porosity Test.—A hose will be selected at random and filled with air at 140 pounds pressure for five minutes. At the end of this time the rubber cover will be split with a knife and the hose submerged under water. This test is to determine the porosity of the inner tube. The escape of air must be distinct enough so that the porosity will not be confused with the escape of air which is confined within structure of the hose. This test determines whether or not the lot of two hundred is accepted or rejected.

Bursting Test.—The hose selected for test will have a section 5 inches long cut from one end, and the remaining 17 inches will then be subjected to a hydraulic pressure of 200 pounds per square inch, under which pressure it shall not expand more than ¾ inch in circumference nor develop any small leaks or defects. This section must then stand a hydraulic pressure of 500 pounds per square inch for ten minutes without bursting.

Friction Test.—A section 1 inch long will be taken from the 5-inch section previously cut off and the quality determined by suspending a 20-pound weight to the separated end, the force being applied radially and the amount of unwinding shall not exceed 8 inches in ten minutes.

Stretching Test.—Another section 1 inch long will be cut from the remainder of the 5-inch piece, and the rubber tube or lining will be separated from the ply and cut at the lap. Marks 2 inches apart will be placed on the section, and then the section will be quickly stretched until the marks are 10 inches apart and immedately released. The section will then be remarked as at first and stretched to 10 inches and will remain so stretched 10 minutes. It will then be completely released, and within thirty seconds of the time of releasing the distance between the marks last applied will be measured, and the initial set must not be more than ¼ inch. At the end of ten minutes, distance between the marks will be again measured, and final set must be not more than ⅛ inch. The small strips taken from the cover will be subjected to the same test.

Tensile Strength.—With a specially designed die of the following dimensions:

Test pieces will be cut from the tube and cover and pulled in a tensile machine with a test speed of 20 inches per minute. After an elongation of at least 10 inches, the inner tube must have a tensile strength of between 800 and 1,200 pounds per square inch, and the cover 700 to 1,100 pounds per square inch.

Sampling.—For each lot of two hundred, one extra hose shall be furnished free of cost.

SIZE AND DIMENSIONS.

	Air-Brake Hose, Inches.	Air-Signal Hose, Inches.
Length—		
Maximum	22½	22½
Minimum	22	22
Outside diameter—		
Maximum	2⅛	1⅞
Minimum	2 1/16	1 13/16
Inside diameter—		
Maximum	1 7/16	1 3/16
Minimum	1⅜	1⅛
Thickness of cap vulcanized on—		
Maximum	3/32	3/32
Minimum	1/32	1/32

Hose shall be smooth and regular in size throughout its entire length.

WORKMANSHIP.

Tube.—The tube shall be made either by hand or machine. It shall be free from holes and imperfections, and in joining must be so firmly united to the cotton fabric that it can not be separated without breaking or splitting the tube. The tube shall be of such a composition and so cured as to successfully meet the requirements of the tests given in Sections 6 and 7, the tubes to be not less than 3/32 inch thick at any point.

Wrapping.—The canvas or woven fabric used as a wrapping for the hose is to be made of long-fiber cotton, loosely woven, from 38 to 40 inches in width, and to weigh not less than 20 to 22 ounces per yard, respectively, this to be determined by the following number of threads to the inch:

Warp .....25 threads per inch.
Filler .....18 threads per inch.

Tensile strength of single threads:

Warp .....not under 12 pounds.
Filler .....not under 9 pounds.

The wrapping shall be frictioned on both sides, and shall have in addition a distinct coating or layer of gum between each ply of wrappings. The canvas wrapping shall be applied on the bias and edges lapped at least ½ inch. Woven or braided covering should be loose in texture, so that the rubber on either side will be firmly united.

Cover.—The cover shall be of the same quality of gum as the tube and shall not be less than 1/16 inch thick.

MARKING.

Serial Number.—Each lot of two hundred or less must bear the manufacturer's serial number, commencing at "1" on the first of the year and continuing consecutively until the end of the year.

Label.—Each length of hose shall have vulcanized on it the label for air-brake hose of red or white rubber as shown under the specifications for "Label for Air-Brake Hose."

INSPECTION.

Rejection.—If the test hose fails to meet the required test, the lot from which it was taken may be rejected without further examination and returned to the manufacturer.

Inspection.—Inspection shall be made at destination. If the test hose is satisfactory, the entire lot will be examined and those complying with the specifications will be accepted.

Freight Charges.—Rejected material will be returned to the manufacturer, who shall pay freight charges both ways.

Committee: M. K. Barnum (Chairman), T. H. Goodnow, I. S. Downing, C. D. Young, A. J. Cotta, J. R. Onderdonk.

Discussion.

C. A. Schroyer (C. & N.-W.)—There is no benefit in a hose that is made parallel and it increases the cost. The manufacturers say they cannot make a hose 3/16 inch larger without increasing the cost.

C. D. Young (Penn.)—It is difficult to wrap cloth over the two different dimensions. The present standard is quite satisfactory, and if anyone is buying hose with expanded ends, it is not M. C. B. standard as I understand it. Tests are being made in a number of laboratories on various roads to determine the rate of deterioration.

D. F. Crawford (Penn.)—I move that the recommendation of the committee be referred to letter ballot for adoption as standard practice in place of the one we now have.

This motion was carried.

M. K. Barnum read a supplementary report on air brake specifications, in which it was stated that the diameter of the gaskets used must agree with the A. R. A. ruling made in 1909. He then moved that these gasket specifications be submitted to letter ballot as a separate question. This motion was carried.

REVISION OF FORM OF PRESENT SPECIFICATIONS.

The committee on Revision of Form of Present Specifications reviewed the existing M. C. B. specifications with a view of harmonizing the form without any change in substance, and, in order to

accomplish this, an outline of instructions was prepared to guide the committee in its work. The subject matter of the outline was largely obtained from the existing standard of the committee on style of the American Society for Testing Materials.

After rewording the specifications, which it was felt should be handled by the committee, they were submitted to the various chairmen interested in the subjects for their approval, which we have obtained, and, therefore, we would recommend as follows:

That the instructions covering the form of specifications be adopted by the Association for future committees in preparing specifications, which form was shown in Exhibit "A."

That the specifications for iron axles be discontinued from the standards of the Association, as material of this kind is no longer purchased in any quantity.

It was found in rewording the specifications that there are certain items in the rejection limits which could, to advantage, be corrected. and we would recommend that a committee be appointed to review these specifications in order to bring them up to present-day practice. This refers especially to specifications covering steel axles.

Specifications do not exist for the following classes of material which are largely used by the members of the Association, and we would recommend that consideration be given to the drafting of specifications covering this material for the use of the members:

Structural steel for passenger and freight cars.
Steel plate for passenger and freight cars.
Carbon-steel forgings for passenger and freight cars.
Rivet steel for passenger and freight cars.
Blooms and billets for forgings for passenger and freight cars.
Steel castings for passenger and freight cars.
Malleable castings for passenger and freight cars.
Mild-steel bars for passenger and freight cars, for miscellaneous parts such as bolts, handbolts, step treads, etc.
Refined merchant bar iron for passenger and freight cars.
Journal-box brasses for passenger and freight cars.
Insulating properties of refrigerator cars.
Hard-drawn copper wire.
Medium hard-drawn copper wire.
Soft and annealed copper wire.
Paint for freight equipment cars.
Pipe for passenger and freight cars.
Galvanized sheets for passenger and freight cars.
Chain for passenger and freight cars.
Spring steel for passenger and freight cars.
Journal-box packing for passenger and freight cars.
Heat-treated knuckle pivot pins.

The work of this committee convinces it that there is a large amount of work which can be done by such a committee as this in assisting various committees on material in formulating their specifications, and recommend that this committee be continued, either as a standing committee or a special committee, but, if it is made a standing committee, would recommend that the Secretary of the Association be made the permanent chairman.

The committee desires to thank the various chairmen of committees for their co-operation in the work which has been undertaken this year, and wishes to acknowledge with thanks the assistance received from the Secretary of the American Society for Testing Materials in formulating the specifications as proposed.

Committee: C. D. YOUNG (Chairman), J. W. TAYLOR, J. S. SHEAFE.

Discussion.

D. F. Crawford—I move that the report be approved and the secretary be instructed to embody the specifications submitted in the reports, and that other subjects requiring consideration be referred to the executive committee.

C. F. Giles (L. & N.)—It would seem dangerous to eliminate the specifications on iron axles.

C. E. Fuller—The motion does not contemplate eliminating any specifications.

The motion was carried.

CAR CONSTRUCTION.

The subjects referred to this committee have been carefully studied, and report thereon, with recommendations, follows:

Subject No. 1: Center Sill Strength, Minimum, for Steel and Steel Underframe Cars, to Resist End Strains.

The subject has been divided into two parts:

(a) Center sills for existing cars.

(b) Center sills for new cars.

The only precedent we have is that of wooden cars. The experience with steel and steel underframe cars extends over a period of about fifteen years. This experience covers a large number of car types, showing great variations in end strain resisting qualities.

It was agreed that the relative values of steel and wood used in car construction for direct tension or compression should be based on the elastic limits of these materials, and that the committee use a ratio of four for the elastic limit of steel to that of oak or yellow pine.

Compared with a wooden car having two 4-inch by 8-inch center sills, an equivalent steel car must have an effective center sill area of not less than 16 square inches between the points where end strain takes effect. The strains in car underframes due to lading do not add greatly to the stresses from end shock. As a rule, a loaded car is less liable to damage from end strains than an empty car, for which reason it will not be necessary to introduce load strains, but base the minimum area and end-resisting strength on end strains only.

Modern steel cars have the center line of draft at varying distances below (seldom above) the horizontal neutral axis of the center sills, and draft stops riveted to the center sills. The distance between the neutral arm, through which bending effect is added to direct tension or compression. Strains which do not act in line with the neutral axis of car members will be designated "Eccentric Strains." The ratio

of stress to strain is $\frac{I}{A}$ plus $\frac{X}{SM}$, in which

A represents area, in square inches.

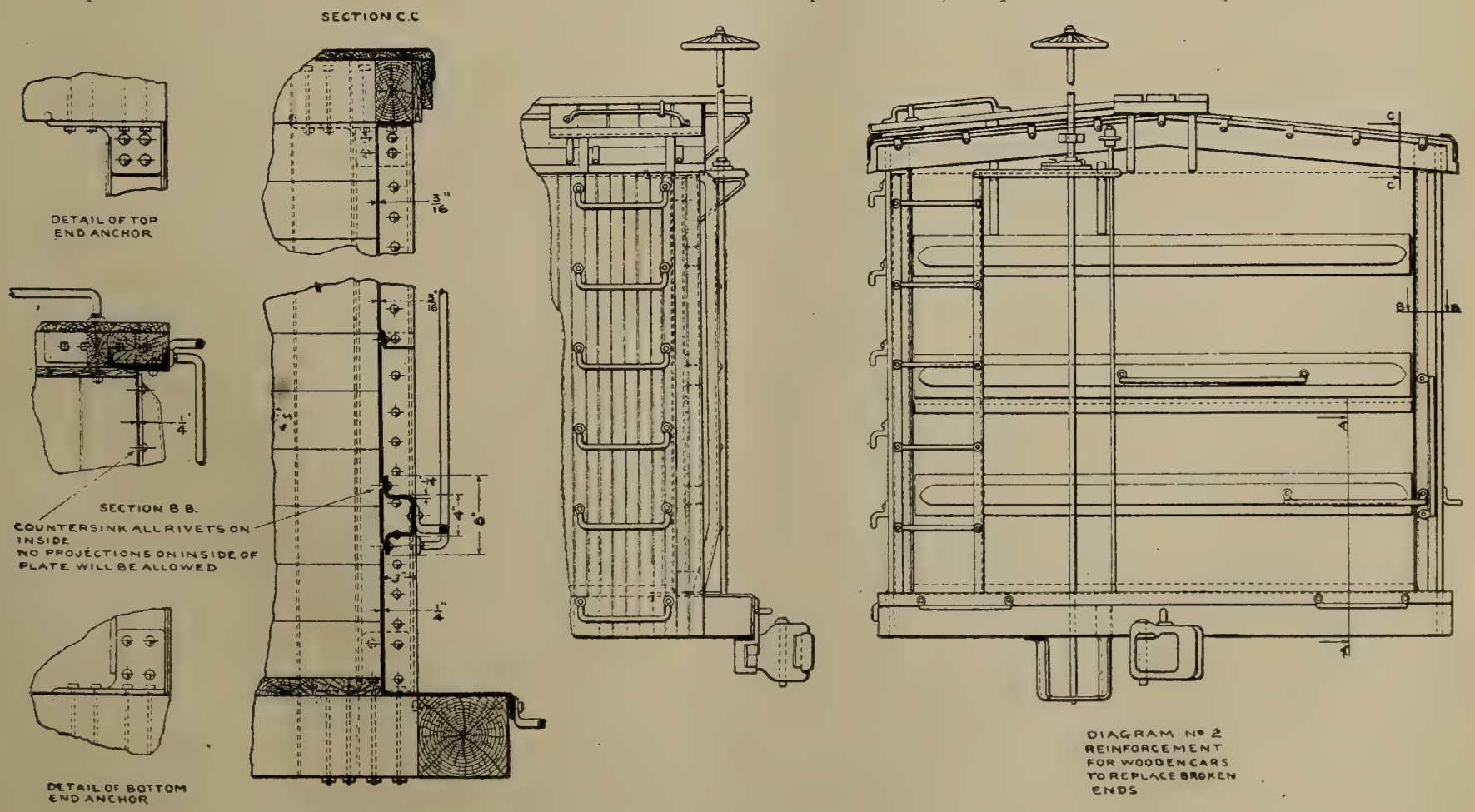

SECTION C.C
DETAIL OF TOP END ANCHOR
3/16
SECTION B B.
COUNTERSINK ALL RIVETS ON INSIDE.
NO PROJECTIONS ON INSIDE OF PLATE WILL BE ALLOWED
DETAIL OF BOTTOM END ANCHOR
SECTION A A
DIAGRAM No 2
REINFORCEMENT FOR WOODEN CARS TO REPLACE BROKEN ENDS

Fig. 2.

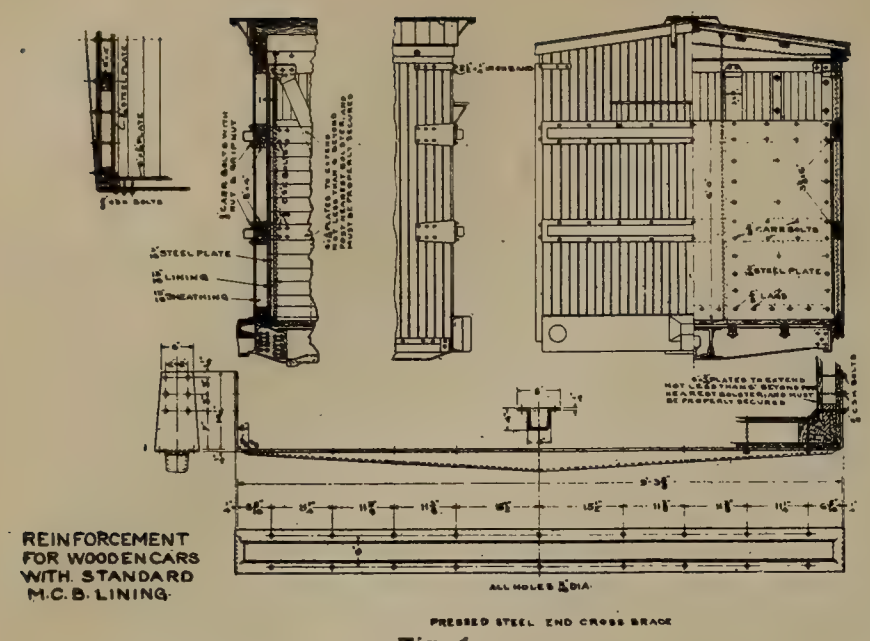


Fig. 1.

X represents lever arm, in inches.

SM represents section modulus of section.

Center sills which are not properly tied together at rear draft stops, located at some distance from bolster, are subject to eccentric strains, which have a tendency to deflect them outward or away from the center line of car between draft stops and bolster.

Compression strains acting on car through draft gear, or car ends, as the case may be, create strut action in the members of the car framing. Long struts are liable to buckle under compression, for which reason it is customary to set limits for ratio of length to radius of gyration of struts, in order to restrict the excess stress caused by this buckling tendency. The members or parts of members of car framing which require consideration are generally flanges of channels or "I" beams, and plates. Their cross sections are rectangular, or sufficiently close to rectangular to be so considered in order to avoid theoretical computations.

The committee recommends the adoption of a ratio of 70 for length to radius of gyration, which corresponds closely with a ratio of 20 for length to depth "d" of a rectangular section. This depth must be measured in the direction in which buckling may take place.

To fulfill the restrictions just given, the length of a member should not be greater than 20 d., or the member must be securely anchored at intervals not exceeding 20 d.

The anchorage of center sills may be accomplished in various ways, the more common methods being by means of cover plates, or diagonal braces. The value of such braces increases the value of the center sills. Cover plates add direct value, and diagonal braces add partial value, depending on their angularity. Braces at right angles to center sills add no value to the center sill area, unless specifically designed as horizontal girders of sufficient strength to transfer all of the end strains from the draft to the side framing, in which case the side framing must perform the functions of center sills, and must be subject to the same rules. The value of braces at point of minimum strength may be added to the center sill area, taking effect in the horizontal plane in which such value lies.

Recommendations.

(a) Existing Steel or Steel Underframe Cars, which have less strength than that specified below, should be classified with wooden cars, and subject to the same rules for combination defects:

Area of center sills not less than 16 square inches.

Ratio of stress to end strain not more than 0.09.

The length of center or draft sill members, or part of member between braces, to be not more than 20 d. where "d" is the depth of the member, measured in the direction in which buckling might take place.

For new cars to be built after 1913 a greater strength should be required. Transportation requirements have increased greatly in the last ten years. Heavy freight locomotives, including Mallet road engines, greater efforts to pass cars through yards quickly, and rougher handling of cars, have increased the strains to cars, due to end shock, at least 50 per cent. Manufacturers of couplers, draft gears, draft attachments, etc., are all busy increasing the strength of their specialties, and are generally aiming to obtain double the original strength.

Recommendations for New Cars.

Area of center sills, not less than 24 square inches.

Ratio of stress to end strain, not more than 0.06.

The length of center or draft sill members, or part of member between braces, to be not more than 20 d. where "d" is the depth of the member, measured in the direction in which buckling might take place.

Subject No. 2: Box Car End Design and Strength.

Mr. F. F. Gaines suggested to the M. C. B. Association that designs of end framing of box cars, to prevent damage to car by shifting load, be submitted.

An investigation of box car repairs leads to a realization of the ever-increasing damage to box car ends and consequent expense of repairs. Wooden ends without metal reinforcement no longer meet transportation requirements; therefore metal ends and metal reinforcements have been applied, tested, and found much superior to wooden ends. Metal ends can be used either with or without wood lining. When using metal ends without wood lining, the inside surface of the plate must have no projections, such as bolt or rivet heads. Col. B. W. Dunn, under date of March 21, 1913, advised as follows: "Paragraph 1662 (f), I. C. C. Regulations, prescribes that in a freight car to carry dangerous explosives special care must be taken 'to have no projecting nails or bolts or exposed pieces of metal which may work loose or produce holes in packages of explosives during transit.' It is hoped, therefore, that you will be able to arrange the design so that the rivet heads will not project. If there is to be no interior wooden lining, and projection of the rivets cannot be avoided, it would seem that the federal regulations would require a special wooden lining to be placed in the end of a car of this kind at least as high as the lading of explosive packages. I do not interpret the federal regulations to forbid the presence of flat metal surfaces, such as this reinforcing plate would be if the rivet heads did not project."

Recommendations.

(a) Wooden cars with standard M. C. B. lining should have the ends reinforced with metal construction in accord with Fig. 1, or its equivalent.

(b) Steel underframe cars with end lining 1½ inches thick and over should be equipped with outside braces, shown on Fig. 1, but the inside plate may be omitted. In applying outside braces, due regard must be given to compliance with United States safety appliance rules for coupler and end ladder clearances.

(c) Cars with wooden superstructure, requiring complete renewal of ends, should have steel ends applied, in accord with Fig. 2, or its equivalent.

(d) New cars should be equipped with ends of the type shown on Figs. 3 and 4. The section modulus of the posts and braces, 2 feet above floor line, not including corner posts or flat end plate, should not be less than 15. The Murphy or Van Dorn steel ends can be used instead of those shown on figures Nos. 1, 2, 3 and 4.

(e) Each end must be attached to the longitudinal car members, either directly or through other members, by fastenings sufficient in strength to develop the full strength of the end.

(f) The constructions shown in the diagrams are equally applicable to outside or inside end sill cars by modifying the attachment at bottom to suit design of end sill.

Subject No. 3: Seal Records of Box Car End Doors.

Mr. T. H. Goodnow, chairman of the committee on Revision of Standards and Recommended Practice, referred a letter from Mr. W. H. V. Rosing to the M. C. B. Association, asking to have it referred to the committee on Car Construction for report. This letter questioned the necessity for end doors and took up the difficulty of obtaining seal records of same.

Both kinds of cars—those with and those without end doors—used for the purpose of loading lumber have been common in years past, but each year fewer new cars with end doors are built, because the end doors are valuable only on roads handling long lumber directly from the lumber regions as an important feature of traffic. Roads which formerly equipped all box cars with end doors have eliminated them from new cars, and are permanently fastening them in place on some of their old cars, leaving the end doors operative only on short box cars. This indicates that with the advent of the 40-foot box car the end doors will gradually become obsolete.

Recommendations.

(a) End doors used for loading lumber in box cars are essential only on roads having long lumber loading in box cars as an essential feature of traffic.

(b) End doors must be so constructed that when closed they lock automatically, by means of a lock accessible only from the inside of the car, thus avoiding the necessity of taking seal records.

(c) Seal appliances now in use, and not accessible from ground or from end ladders, should be revised so as to be accessible from ground or end ladders, to promote the safety of employees.

Committee: W. F. Kiesel, Jr. (Chairman), C. A. Seley, A. R. Ayers, S. G. Thomson, C. E. Fuller.

Discussion.

R. E. Smith (A. C. L.)—I would like to ask the committee if in their recommendations with regard to end doors they have not overlooked a class of cars used for handling perishable fruit and vegetables which is equipped with end doors. It is important at one stage of the journey that the end door should be open for ventilation, and that as it moves into a colder country it should be closed. From the standpoint of the Southern lines we couldn't accept these recommendations. I would ask if the committee had in mind end doors for lumber only, or for all box cars.

W. F. Kiesel (Penn.)—We had in mind only end doors for lumber. Recent end doors for fruit cars have ventilators put in solidly and cannot be entered.

R. E. Smith—The older cars cannot normally be entered, but people in loading in lumber have taken out ventilators and have not replaced

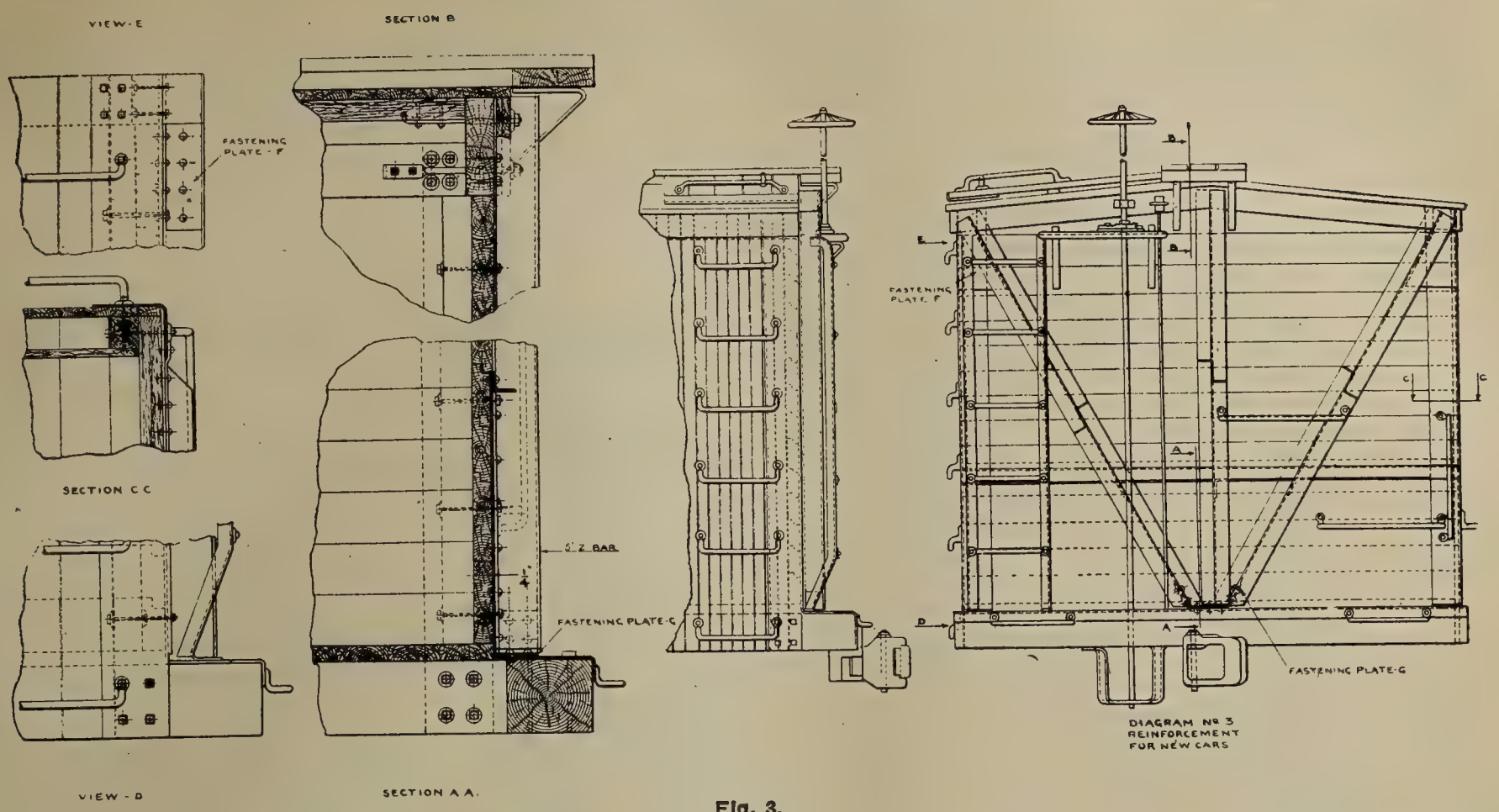


Fig. 3.

them. Most of the pilfering of vegetable cars has taken place from the side.

R. W. Burnett (Can. Pac.)—In comparing steel with wood cars, we have a record of 15-inch center sills being undamaged, while 30-inch center sills were because they were unsupported. It is a mistake to use one formula for all classes of cars. Our experience with steel cars has enabled us to use much lighter center sills. With 20,000 cars with 15-inch center sills and 19.8-inch cross section, no failures have developed. I would recommend as a substitute for the committee's recommendations in this regard that all cars constructed have 18 inches between bolsters, 20 inches between bolsters and end sills, and that after October 1, 1914, all cars with less than these dimensions be considered as wooden cars.

F. F. Gaines—We have used too light material in building our cars in the past. I move that recommendation B be submitted to letter ballot and end construction recommendations be submitted separately.

L. C. Ord (Can. Pac.)—Mr. Gaines failed to consider one point. It is not simply a question of strength of center sills. If we have a steel frame car the strength is in the superstructure as well as in the center sills. Center sills usually fail from the end dropping. It is unfair to put a specification in that a wooden car requires the same as one with a steel superstructure. During the time that our steel box cars have been in service we have had no failures of end sills, and this requires your consideration.

F. F. Gaines (Cent. of Ga.)—We have 100,000 pounds capacity coal cars with light channel center sills, and any number come in with center sills buckled and have to be straightened. I am of the opinion that center sills are too light.

J. J. Tatum (B. & O.)—The president's address brought out the thought of economy very forcibly. Let us build a substantial car that will not find its way to the repair shop so frequently.

J. J. Hennessey (C. M. & St. P.)—Automobile cars have not been referred to at all. Some of these cars have end doors that open the whole end of the car, and also have side doors which are adaptable for both automobiles and grain.

C. A. Schroyer (C. & N.-W.)—If this association does not appoint a standing committee on car construction, it won't be many years before the federal government will do what has been done with regard to safety appliances. We have had trouble with light sills and in ordinary application of the brakes have had cars collapse right on the road.

W. F. Kiesel (Penn.)—With regard to automobile end doors, would say that they have inside locks.

D. F. Crawford (Penn.)—I would like to endorse all that has been said about good cars, and I move that the recommendations of the committee be submitted to letter ballot.

This motion was carried.

O. C. Cromwell (B. & O.)—There are some other subjects which should be referred to the committee on car construction—such as insufficient distance from bolster to end of car, sufficient means of attachment for conveying stresses to the underframe, the question of interference of angle cocks with end sills, and the support of carrier arm of the coupler.

D. F. Crawford (Penn.)—The American Railway Association has under consideration a standard box car, and I move that this committee be transferred from a special to a standing committee.

This motion was carried.

D. R. MacBain—I am in accord with the recommendations of the car construction committee, because it tends toward better construction. I am impressed with the end conditions. Ends on old cars are not sufficiently strong.

C. A. Schroyer—We haul lots of dressed lumber and I note with satisfaction the new improved ends that have lately come on the market. We have gone into end construction lately and have strengthened the corner posts. In tests which we made we found that the ⅞-inch inside lining was not sufficiently strong to resist the thrust, but that 1¼-inch lining would resist it fairly well.

C. F. Giles (L. & N.)—We have more trouble with defective arch bars than any other one thing. A year ago we tried inspecting the inside of the bar with a hand mirror and found thousands defective.

F. W. Brazier—The New York Central is putting in all-steel ends. Wooden ends, which cost within $15 of the steel ends, broke under test, while the steel was only dented.

C. E. Fuller—The managers of the roads look to us as to what should be done in car construction, and it is up to us to recommend what will meet the requirements of the American Railway Association. We must do something. The question of specifications for car construction is part of our work and we should take the initiative.

ELECTION OF OFFICERS.

The report of the committee on correspondence and resolutions was presented and accepted. The application of C. A. Seley for associate membership was presented and, as usual, lays over for one year. The following officers were elected for the coming year:

President, M. K. Barnum, G. M. Ins., B. & O., Baltimore; first vice-president, D. F. Crawford, G. S. M. P., Penna. Lines West, Pittsburgh; second vice-president, D. R. MacBain, S. M. P., L. S. & M. S., Cleveland, Ohio; third vice-president, R. W. Burnett, G. M. C. B., Canadian Pacific, Montreal; treasurer, J. S. Lentz, M. C. B., Lehigh Valley, South Bethlehem, Pa.

The following were elected members of the executive committee: C. E. Fuller, T. M. Ramsdell, C. F. Giles.

The following were selected as the committee on nominations: F. W. Brazier, F. H. Clark, A. W. Gibbs, C. E. Fuller and F. F. Gaines.

S. Blewett presented the ex-presidents' badge to C. E. Fuller and a rising vote of thanks was given Mr. Fuller for the able way in which he had administered his duties.

Exhibitors at the Mechanical Conventions

Among those members of the Railway Supply Manufacturers' Association who exhibited at the convention of the American Railway Master Mechanics' and the Master Car Builders' Convention are the following:

Acme Supply Co., Chicago, Ill.—Represented by H. H. Schroyer and T. K. Dunbar.

American Abrasive Metals Co., New York, N. Y.—Represented by H. W. Mowery and J. P. Warfel.

American Arch Co., New York, N. Y.—Represented by Le Grand Parish, John P. Neff, W. L. Allison, J. T. Anthony, George Wagstaff, M. K. Tate, Chas. Coons and C. E. Miller. Spaces 412, 414.

American Balance Valve Co., Jersey Shore, Pa.—Represented by J. T. Wilson, Frank Trump and C. C. Young.

American Brake Co., The, St. Louis, Mo.—Represented by R. E. Adreon and F. E. Schwentler.

American Brake Shoe & Foundry Co., Mahwah, N. J.—Represented by R. M. Brower, F. H. Coolidge, J. R. Haywood, R. E. Holt, E. L. Janes, G. R. Law, W. S. McGowan, F. W. Sargent, J. S. Thompson, J. B. Terbell, L. R. Dewey, J. G. Tawse, C. P. Wright and F. L. Gordon.

American Brass Co., Ansonia, Conn.—Represented by Wm. H. Rippere, R. S. Wildman and W. W. Cotter.

American Car & Foundry Co., New York, N. Y.—Represented by Scott H. Blewett, Clark Dickerman, Clark D. Eaton, Wm. C. Dickerman and John McE. Ames.

American Car & Ship Hardware Manufacturing Co., New Castle, Pa.—Represented by P. J. Flaherty and F. H. Babcock.

American Flexible Bolt Co., Pittsburgh, Pa.—Represented by C. A. Seley, J. A. Frauenheim, H. T. Frauenheim and Ethan I. Doods.

American Locomotive Co., New York, N. Y.—Represented by James McNaughton, J. D. Sawyer, J. E. Dixon, C. J. Donahue, H. B. Hunt, J. B. Ennis, W. P. Steele and W. L. Reid.

American Mason Safety Tread Co., Boston, Mass.—Represented by Henry C. King, L. H. Myrick and R. C. Davison.

American Nut & Bolt Fastener Co., Pittsburgh, Pa.—Represented by O. A. Blackburn, Robt. Spencer, Christopher Murphy and Edwin M. White.

American Piston Co., Indianapolis, Ind.—Represented by F. O. Fitton, V. D. Morrison and S. P. Morrison.

American Pulley Co., The, Philadelphia, Pa.—Represented by Morris W. Rudderow.

American Roll Gold Leaf Co., Providence, R. I.—Represented by T. J. Lawler, G. E. Lawler, Chas. H. Bowers and Charles E. Smith.

American Steam Gauge & Valve Manufacturing Co., Boston, Mass.—Represented by R. B. Phillips, E. H. Smith, P. H. Ryan and C. A. Allen.

Looking Down the Annex.

American Steel Foundries, Chicago, Ill.—Represented by R. P. Lamont, Geo. E. Scott, R. H. Ripley, W. J. Lynch, T. D. Kelley, J. V. Bell, G. F. Slaughter, W. Ross Gravener, George C. Murray, Theo. Cook, P. J. Kalman, D. T. Harris, J. W. Dalman, W. A. Blanchard, A. S. Crozier, T. H. Hopkirk, W. M. Rogovine, P. A. Martin, M. R. Maclean, R. E. Janney, Geo. G. Floyd, F. B. Ernst, H. Blanchard, W. G. Wallace, J. W. Weinland and Louis E. Jones.

American Tool Works Co., The, Cincinnati, Ohio.—Represented by R. S. Alter, C. K. Cairns, H. W. Schatz and J. C. Hussey.

American Vanadium Co., Pittsburgh, Pa.—Represented by W. A.

The Striking Booth of the Buffalo Foundry-Machine Co.

ENTERTAINMENT COMMITTEE.

Top Row, Left to Right—R. J. Faure, W. C. Wardell, H. A. Neally, J. D. Purcell, P. M. Brotherhood, J. M. Crowe, C. D. Eaton, C. J. Donahue, W. S. Furry, W. J. Caton.

Bottom Row, Left to Right—H. S. Hammond, L. B. Sherman, J. P. Landreth, L. J. Hibbard, W. K. Krepps, John D. McClintock, Gilbert E. Ryder, Ed P. Chaffee.

Bonitz, W. J. Bird, G. L. Norris, H. C. Richardson, P. A. Bevan, G. T. Ramsey, E. W. Strong and R. B. Steele.

Anchor Packing Co., Philadelphia, Pa.—Represented by W. R. Haggart, L. E. Adams, J. B. Webb, B. J. Miller, C. M. Barnes, D. J. Murray, A. A. Rute, E. F. James, E. C. Adams, J. F. Edmunds, W. W. Waring and J. D. Maguire.

Ashton Valve Co., The, Boston, Mass.—Represented by Joseph W. Motherwell, Albert C. Ashton, Joseph F. Gettrust and William H. Foster.

Automatic Ventilator Co., New York, N. Y.—Represented by George H. Ford, Wm. J. Fleming, Jr., Harold E. Lavelle and Frank A. Barbey.

Baker Bros., Toledo, Ohio.—Represented by George E. Hallenbeck and W. W. Elliott.

Baldwin Locomotive Works, Philadelphia, Pa.—Represented by Grafton Greenough, L. H. Fry, E. B. Halsey, Charles Riddell, F. W. Weston, W. R. Keys and C. H. Peterson.

Barco Brass & Joint Co., Chicago, Ill.—Represented by F. N. Baird and Lesley W. Millar.

Baush Machine Tool Co., Springfield, Mass.—Represented by Walter H. Foster.

Berry Bros., Detroit, Mich.—Represented by D. W. Moreland, W. E. Paye and Jas. S. Stevenson.

Besly & Co., Charles H., Chicago, Ill.—Represented by Edw. P. Welles, Chas. A. Knill and Wm. H. Allen.

Best, W. N., New York, N. Y.—Represented by B. F. Mears.

Bettendorf Co., The, Bettendorf, Iowa.—Represented by J. W. Bettendorf, J. H. Bendixen, A. F. Macpherson, F. K. Shults, E. E. Silk, J. G. Hope, Peter P. Beck, C. J. W. Clasen, W. G. Ransom and E. J. Bettendorf.

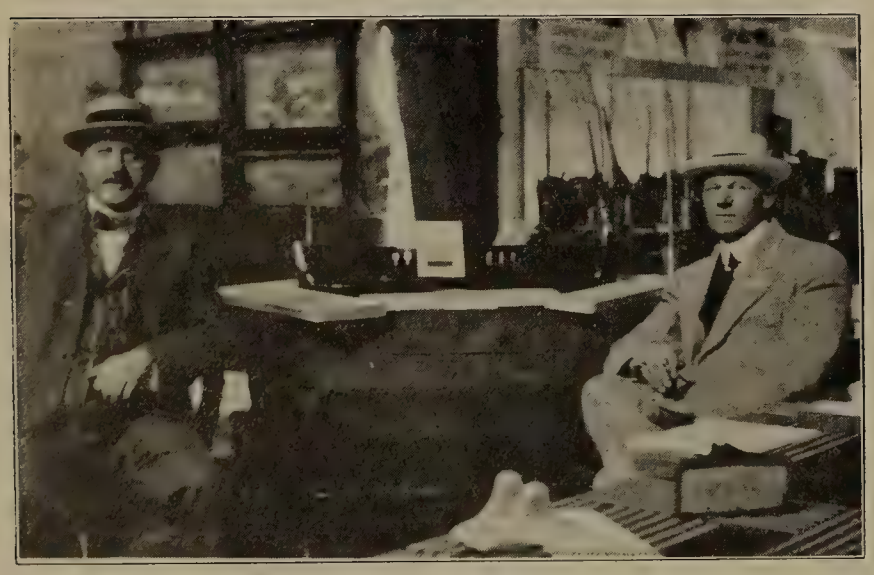
Bird-Archer Co., New York, N. Y.—Represented by F. O. Paige and H. V. Bootes.

Blackall, Robert H., Pittsburgh, Pa.—Represented by Robert H. Blackall and E. Emery.

W. C. Hayes, Supt. Loco. Op., Erie R. R., and E. W. Pratt, A. S. M. P., C. & N.-W. Ry.

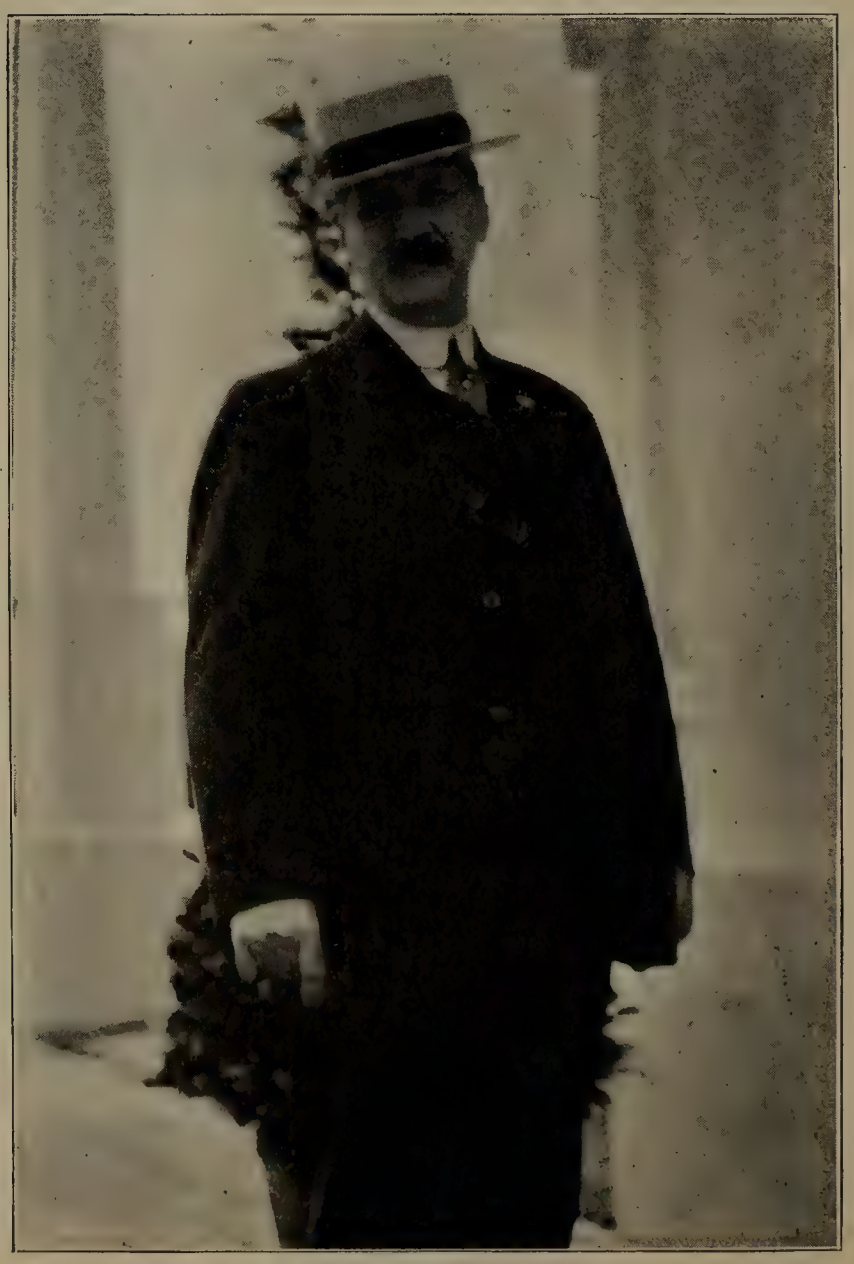
A. N. Dunlap, Dist. Mgr., Bird-Archer Co., Pittsburgh, and C. E. Chambers, S. M. P., Cent. of N. J.

Representatives of the Carborundum Co.—W. W. Sanderson, C. C. Lathrop, R. H. Hogg, R. S. Marvin and C. C. Schumaker.



L. H. Myrick and Ralph C. Davison, American Mason Safety Tread Co.

Exhibit of the U. S. Light & Heating Co.



Jim De Voy, of C., M. & St. P.

Bowser & Co., Inc., S. F., Ft. Wayne, Ind.—Represented by W. T. Simpson, F. T. Hyndman and E. H. Barnes.

Brown Automatic Connector Co., Chattanooga, Tenn.—Represented by M. A. Brown.

Brown & Co., Tom, Chicago, Ill.—Represented by Harry W. Stannard.

Brubaker & Bros., W. L., Millersburg, Pa.—Represented by A. W. Brubaker, W. S. Rose and F. E. Harrison.

Buckeye Steel Castings Co., The, Columbus, Ohio.—Represented by S. P. Bush, J. C. Whitridge, C. B. Goodspeed, George Groobey, George T. Johnson and J. G. Bower.

Buda Co., The, Chicago, Ill.—Represented by Mark A. Ross, H. P. Bayley, W. Krause, T. H. Wheeler and N. C. Study.

Buffalo Brake Beam Co., New York, N. Y.—Represented by S. A. Crone, E. Strassburger, T. E. Carliss, R. C. Fraser and O. W. Meissner.

Buffalo Foundry & Machine Co., Buffalo, N. Y.—Represented by E. G. Rippell, H. D. Miles, David Bell and E. G. Sleeper.

Bullard Machine Tool Co., The, Bridgeport, Conn.—Represented by S. H. Bullard, J. W. Bray, R. H. Snider, J. H. Van Yorx, F. B. Smith, W. B. Price and Geo. E. Merryweather.

Burden Sales Co., New York, N. Y.—Represented by G. H. Pearsall and F. H. Gardner.

Burroughs Adding Machine Co., Detroit, Mich.—Represented by F. A. Willard and D. Lesseig.

Camel Co., Chicago, Ill.—Represented by J. M. Hopkins, A. B. Wegener, J. F. Comee and P. M. Elliott.

Carborundum Co., The, Niagara Falls, N. Y.—Represented by R. S. Marvin, C. C. Schumaker, C. C. Lathrop, W. W. Sanderson and R. H. Hogg.

Carey Co., Philip, The, Cincinnati, Ohio.—Represented by Allan Wallace, D. R. Warfield, N. S. Kenny and P. A. Johnston.

Carnegie Steel Co., Pittsburgh, Pa.—Represented by John C. Neale, W. G. Clyde, I. W. Jenks, John McLeod, R. B. Woodworth, V. S. Yarnall, N. B. Trist, G. F. Goddard, J. C. Neubauer, H. W. Summers, W. N. Jeffress, C. B. Friday, H. L. Baker, W. L. Allen and J. H. McAlarney.

Chase & Co., L. C., Boston, Mass.—Represented by W. P. Underhill and H. T. Wight.

Chicago Car Heating Co., Chicago, Ill.—Represented by Egbert H. Gold, Jos. E. Buker, B. A. Keeler, George T. Cooke, Roswell P. Cooley, Jos. Frumveller, E. E. Smith, Elmer W. Rietz, James R. Reniff, F. F. Coggin and Edward A. Schreiber.

Chicago Pneumatic Tool Co., Chicago, Ill.—Represented by W. O. Duntley, C. E. Walker, W. P. Pressinger, Thomas Aldcorn, J. C. Campbell, J. W. McCabe, C. B. Coates and Edw. Aplin.

Chicago Railway Equipment Co., Chicago, Ill.—Represented by E. B. Leigh, Arthur Wyman, F. T. De Long, G. N. Van Sweringen, E. A. Le Beau, R. H. Pilson, R. J. Sheridan, Ralph M. Wiggins, C. A. Maher and C. H. Williams, Jr.

Chicago Varnish Co., Chicago, Ill.—Represented by George S. Bigelow, A. C. Morgan, O. H. Morgan, R. K. Buckman, Jr., F. N. Gundrum, Jr., and F. L. Olds.

Cincinnati Bickford Tool Co., The, Cincinnati, Ohio.—Represented by Sherman C. Schauer, H. M. Norris and Lee Schauer.

Cincinnati Planer Co., The, Cincinnati, Ohio.—Represented by B. B. Quillen, Charles Meiers and George Langen, Jr.

Coe Manufacturing Co., W. H., Providence, R. I.—Represented by E. J. Arlein, B. A. Smith and S. H. Swallow.

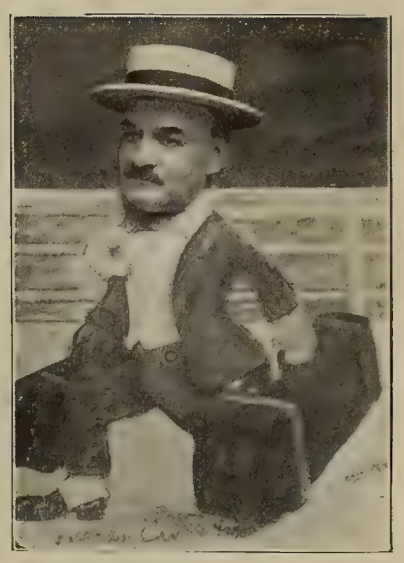
Collins Metallic Packing Co., Philadelphia, Pa.—Represented by J. Geo. Wholey, Michael Collins and James F. Lennon.

Commercial Acetylene Railway Light & Signal Co., New York, N. Y.—Represented by C. E. Lee, D. Ahdin, O. F. Ostby, E. T. Sawyer, H. G. Doran, C. A. McCune and R. J. Faure.

Commonwealth Steel Co., St. Louis, Mo.—Represented by Harry M. Pflager, George E. Howard, Boone V. H. Johnson, Chas. S. Shallenberger and Wm. P. Stout.

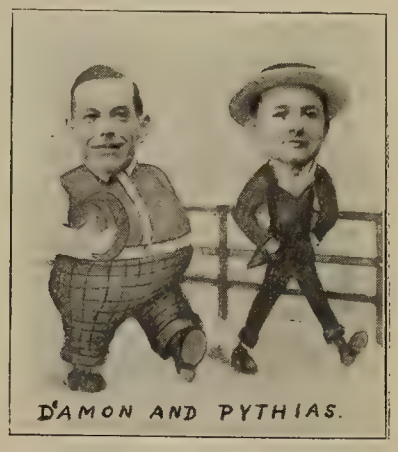
Consolidated Car-Heating Co., Albany, N. Y.—Represented by C. C. Nuckols, Thos. Farmer, Jr., W. S. Hammond, Jr., C. W. Martin, H. Hawley and Butler Keys.

Thornton N. Motley, Attending His Twenty-fifth Convention.



B. E. D. Stafford, of the Flannery Bolt Co.

Geo. Post, Standard Coupler Co., and C. Mason, Consl. Engr., New York.



R. P. Cooley and G. T. Cooke, of the Chicago Car Heating Co.

Richard Golden, of Estate Edward R. Ladew.

F. T. Hyndman, S. M. P., Wheeling & Lake Erie.

H. O. Fettinger, Mgr. R. R. Dept., Clement-Restein Co.

Mr. and Mrs. J. J. Tucker, the Two "Dixonites" Who Never Miss a Convention.

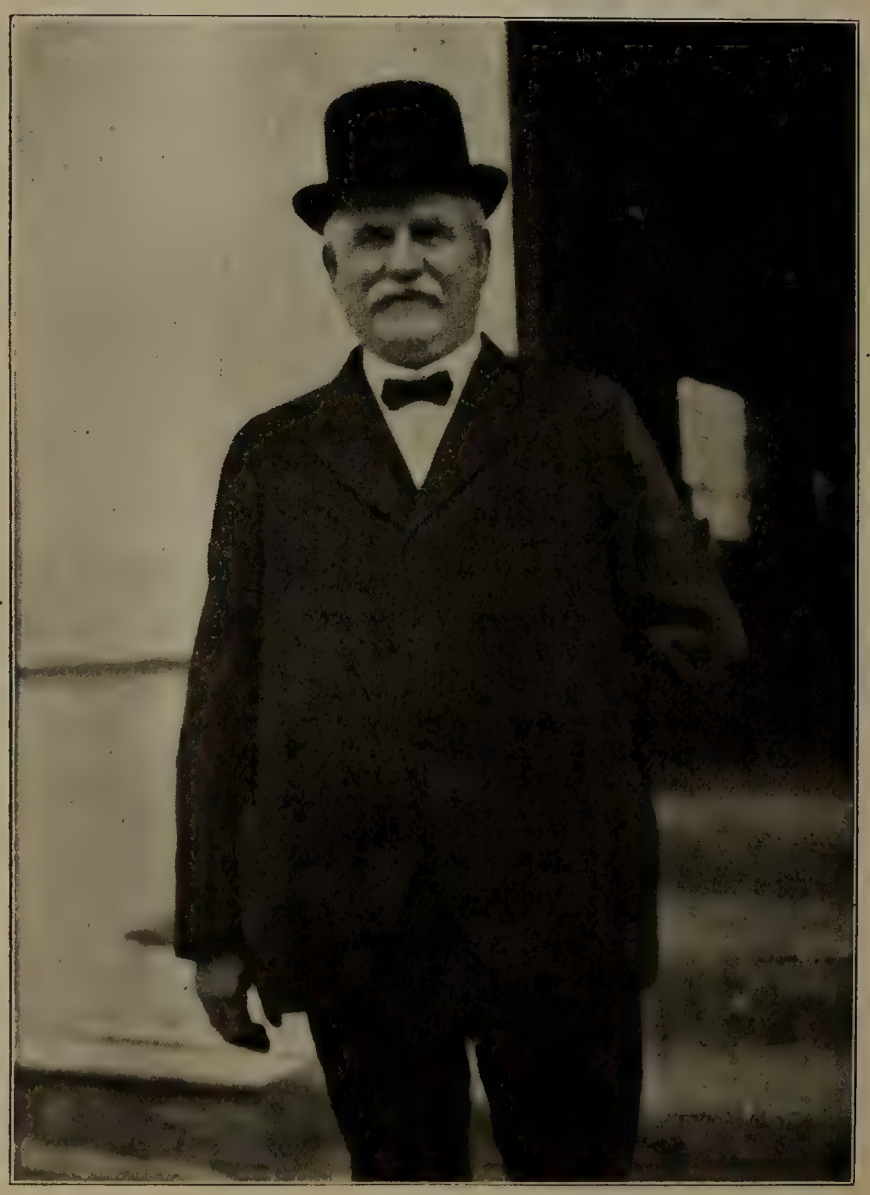
Top Row, Left to Right—Mrs. Charles D. Jenks, Mrs. Burton W. Mudge, Mrs. W. J. Tollerton, Mrs. L. A. Richardson, Mrs. J. S. Sheafe.

Bottom Row, Left to Right—Mrs. B. A. Clements, Mrs. F. O. Bunnell, Mrs. J. P. Landreth.

The McConway & Torley Exhibit.

S. P. Morrison and V. D. Morrison, of the American Piston Co.

W. G. Phelps, Asst. Purchasing Agent, Penna. Lines; E. H. Bankard, Purchasing Agent., Baltimore & Ohio R. R.; H. O. Hukill, Purchasing Agent, Penna. Lines.



S. F. Bowser.

Chas. Shults, of Worth Bros., With His Box of Cigars.

H. W. Jones, Bullard Machine Co., and Chas. Meiers, Cincinnati Planer Co.

Max Goodrich, M. M., Ottawa & N. Y.

Geo. H. Hartman, M. E., Standard Valve Gear Co.

Cooper Hewitt Electric Company, Hoboken, N. J.—Represented by F. M. Haviland and M. B. Buckman, Jr.

Crane Co., Chicago, Ill.—Represented by F. D. Fenn and G. S. Turner.

Crofut, Jr., Ulysses E., Scranton, Pa.—Represented by Ulysses E. Crofut, Jr., and George F. Taylor.

Crosby Steam Gage & Valve Company, Boston, Mass.—Represented by M. D. Johnson.

Curtain Supply Co., The, Chicago, Ill.—Represented by W. H. Forsyth, R. F. Hayes, S. W. Midgley, F. M. Egolf and George E. Fox.

Damascus Brake Beam Co., The, Cleveland, Ohio.—Represented by Albert Waycott.

Davis Boring Tool Co., St. Louis, Mo.—Represented by Emery E. Davis, J. W. McKeen and Theo. Rowe.

Dearborn Chemical Co., Chicago, Ill.—Represented by Robert F. Carr, J. D. Purcell, G. W. Spear, A. W. Crouch, J. F. Franey, J. H. Cooper and H. G. McConnaughy.

DeForest Sheet & Tinplate Co., The, Niles, Ohio.—Represented by Wade A. Taylor and Edward D. Thompson.

Detroit Hoist & Machine Co., Detroit, Mich.—Represented by J. C. Fleming and F. B. Fleming.

Detroit Lubricator Co., Detroit, Mich.—Represented by F. W. Hodges and A. D. Homard.

Diamond Specialty & Supply Co., Philadelphia, Pa.—Represented by W. M. Wills, A. D. Austin, T. R. Hood, L. deL. Berg and C. E. Miser.

Dickinson, Inc., Paul, Chicago, Ill.—Represented by A. J. Filkins and J. A. Meaden.

Dieter Nut Company, New York, N. Y.—Represented by P. W. Dieter and H. L. Winslow.

Dixon Crucible Co., Joseph, Jersey City, N. J.—Represented by H. A. Nealley, J. A. Tucker, Wm. Houston, H. W. Chase and L. H. Snyder.

Draper Manufacturing Co., The, Port Huron, Mich.—Represented by Thomas Draper.

Duff Manufacturing Co., The, Pittsburgh, Pa.—Represented by T. A. McGinley, E. A. Johnson and C. A. Methfessel.

DuPont de Nemours Powder Co., E. I., Wilmington, Del.—Represented by J. K. Rodgers and C. Hallock Silkman.

Eagle Glass & Manufacturing Co., Wellsburg, W. Va.—Represented by J. L. Fusner and S. A. Paull.

E. D. E. Co., Chicago, Ill.—Represented by Frank M. Gilmore.

Edison Storage Battery Co., Orange, N. J.—Represented by R. A. Bachman, W. G. Bee, H. G. Thompson, F. V. McGinness, C. A. Luckey and O. Hildebrandt.

Edwards Co., Inc., The O. M., Syracuse, N. Y.—Represented by O. M. Edwards, E. F. Chaffee, C. H. Rockwell, W. C. Bradbury and T. P. O'Brian.

Electric Controller & Manufacturing Co., The, New York, N. Y.—Represented by R. G. Widdows, E. C. Ryan and W. C. Jackson.

Electric Storage Battery Co., The, Philadelphia, Pa.—Represented by Charles Blizard, F. L. Reynolds, F. L. Kellogg, J. L. Woodbridge, F. G. Beetem and H. E. Hunt.

Elwell-Parker Electric Co., The, New York, N. Y.—Represented by Lucian C. Brown and George W. Brown.

Emery Pneumatic Lubricator Co., The, St. Louis, Mo.—Represented by E. A. Emery, H. C. Miller and G. L. Janis.

Equipment Improvement Co., New York, N. Y.—Represented by W. E. Weatherly and O. J. Jensen.

Eveland Engineering & Manufacturing Co., Philadelphia, Pa.—Represented by S. S. Eveland, H. F. Martin, Howard Engard, Frank Nunn and E. C. Hawley.

Fastnut, Ltd., London, England.—Represented by W. H. Cook.

Federal Engineering Co., The, Wilmington, Del.—Represented by Howard L. Pyle and Frank F. Slocomb.

Flannery Bolt Co., Pittsburgh, Pa.—Represented by J. Rogers Flannery, B. E. D. Stafford, Tom R. Davis, W. M. Wilson, George E. Howard, James J. Flannery, Thomas J. Leahey and Barton H. Grundy.

E. A. Miller, S. M. P., N. Y., C. & St. L. R. R.

W. E. Weatherly, V. P., Equip. Improvement Co.

Ed G. Johns, Genl. Mgr., Natl. Graphite Lubricator Co.

A. H. Ackerman, Genl. Mgr., U. S. Light & Heating Co.

E. S. Strassburger, S. H. Crone, T. E. Carliss and R. T. Fraser, of the Buffalo Brake Beam Co.

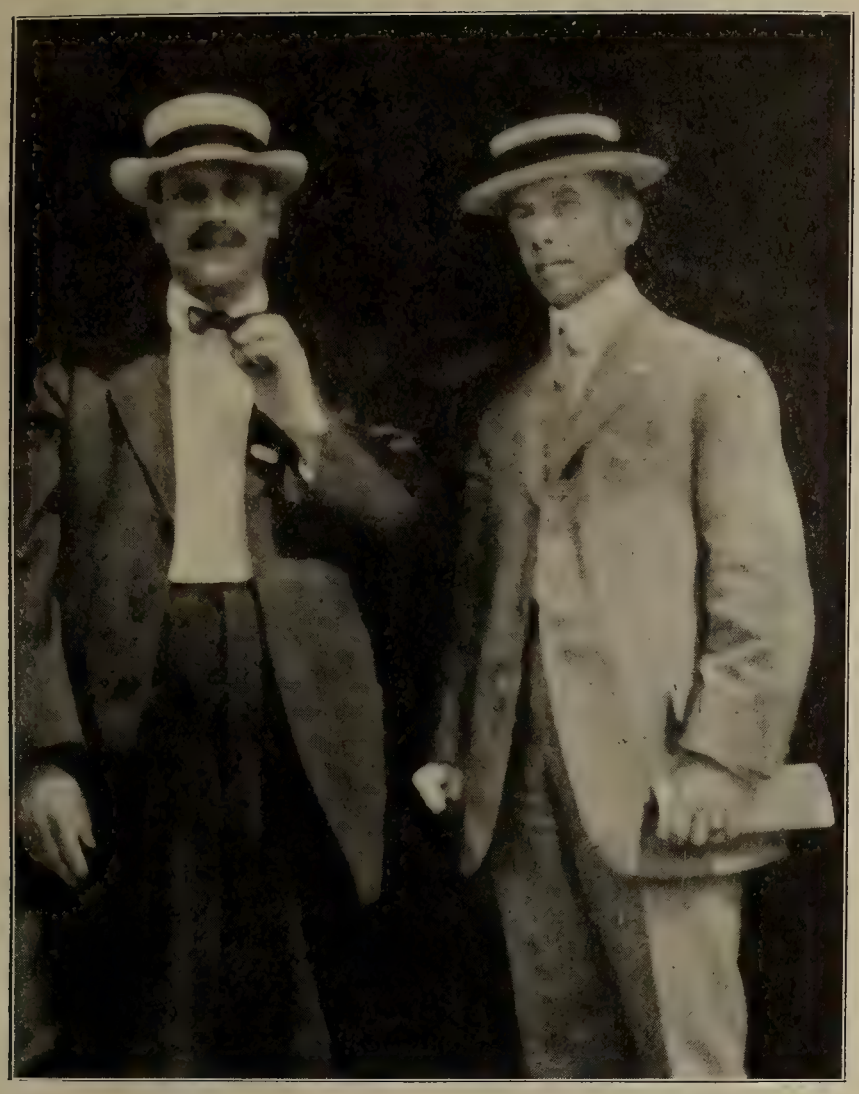
W. B. Waggoner, Butler Drawbar Co.; Allen Sheldon, Manufacturers' Exhibit (Karpen Building, Chicago), and "Colonel" Risley, of The Railway List Co.

C. W. Wright, of the Steel Car Forge Co.; J. M. Crowe, and a Rear View of J. G. Neuffer, S. M. P., Chicago Great Western R. R.

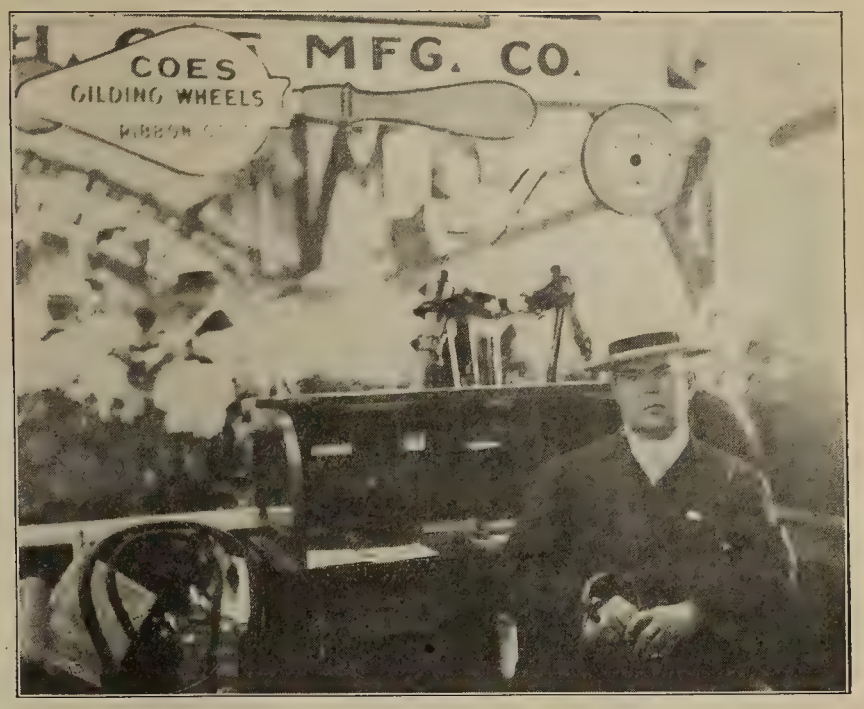
Henry Boutet, Chief Interchange Inspector, Cincinnati, O.

A. B. Lacy, Pur. Agt., Virginian Ry., and Mrs. Lacy.

Left to Right—Wm. Schlafge, G. M. Supt., Erie R. R.; Jos. Goddard and V. S. Yarnall, Carnegie Steel Co.



J. M. Robb, Bird-Archer Co., and M. K. Barnum, Genl. Mech. Ins., Baltimore & Ohio R. R.



E. J. Arlein, of W. H. Coe Mfg. Co.

Geo. A. Cooper, Frost Railway Supply Co., and C. E. Fuller, A. G. M., Union Pacific.

F. F. Gaines, S. M. P., Cent. of Ga. Ry., with H. S. Hayward, Jr., of the Franklin Mfg. Co. at His Right.

One-half of E. E. Davis, President, Davis Boring Tool Co.; Also J. M. McKeen and Theo. Rowe.

Forged Steel Wheel Co., Pittsburgh, Pa.—Represented by J. B. Brady, R. L. Gordon, J. P. Rapp, C. G. Bacon, H. G. Macdonald and W. A. Libkeman.

Fort Pitt Malleable Iron Co., Pittsburgh, Pa.—Represented by Frank J. Lanahan.

Franklin Railway Supply Co., New York, N. Y.—Represented by Samuel G. Allen, W. L. Allison, R. G. Coburn, J. S. Coffin, C. W. F. Coffin, W. H. Coyle, A. G. Elvin, J. L. Mohun and S. D. Rosenfelt.

Frost Railway Supply Co., The, Detroit, Mich.—Represented by Harry W. Frost, George A. Cooper and George L. Harvey.

Galena-Signal Oil Co., Franklin, Pa.—Represented by S. A. Megeath, C. C. Steinbrenner, E. H. Baker, Colonel B. H. Grundy, F. A. Guild, J. E. Hall, William Holmes, Robert McVicar, W. A. McWhorter, George L. Morton, W. A. Trubee, W. J. Walsh E. V. Sedgwick, H. Hillyer, J. G. Arn, J. W. Bunn, B. P. Corey, J. S. Brown, Colonel E. W. Grieves, E. W. Hayes, D. L. Eubank, E. G. Johnson, G. E. McVicar, C. B. Royal, L. H. Palmer, J. C. Sibley, Jr., F. B. Smith, W. O. Taylor, W. F. Walsh, R. E. Webb and J. A. Whalen.

Garlock Packing Co., The, Palmyra, N. Y.—Represented by H. N. Winner, J. P. Lamdreth, Phil Arnold, T. P. Dunham, W. F. Girten and L. P. Duggan.

General Electric Co., Schenectady, N. Y.—Represented by C. E. Barry, R. S. Bennett, B. F. Bilsland, W. J. Clark, C. Fair, F. H. Gale, J. W. Ham, J. M. Hollister, W. O. Kellogg, C. B. Keyes, E. E. Kimball, C. D. Knight, R. E. Moore, C. C. Pierce, C. A. Raymond, Frank Rhea, J. Seede, L. W. Shugg, J. O. Weatherbie and R. E. Wooley.

General Railway Supply Co., Chicago, Ill.—Represented by F. L. Wells, H. U. Morton, W. S. Humes, J. F. Oelerich.

Gilbert & Barker Manufacturing Co., Springfield, Mass.—Represented by C. F. Hatmaker.

Gold Car Heating & Lighting Co., New York, N. Y.—Represented by Edward E. Gold, E. B. Wilson, A. B. Strange, W. H. Stocks, G. F. Ivers, J. M. Stayman, F. A. Purdy, F. O. Bailey, E. J. Ronan, F. H. Smith, A. D. Sturver, J. O. Brumbaugh and F. T. Kitchen.

Goldschmidt Thermit Co., New York, N. Y.—Represented by William C. Cuntz, F. C. Cohen, H. S. Mann, W. R. Hulbert, H. D. Kelley, William Aldrich and J. G. McCarty.

Goodyear Tire & Rubber Co., The, Akron, Ohio.—Represented by I. R. Bailey, F. J. Blake, A. N. Canfield, G. D. Pilgrim, L. H. Conger, C. A. Jones and D. R. Burr.

Gould & Eberhardt, Newark, N. J.—Represented by H. Ezra Eberhardt and Charles L. Cameron.

Gould Coupler Co., New York, N. Y.—Represented by F. P. Huntley, George G. Milne, W. F. Richards, Dr. C. W. Gould, Clarence E. Rood, Col. John T. Dickinson and George R. Berger.

Greene, Tweed & Co., New York, N. Y.—Represented by L. J. Van De Wall and A. J. Richardson.

Greenlaw Manufacturing Co., The, Boston, Mass.—Represented by H. A. Royce and A. L. Greenlaw.

Griffin Wheel Co., Chicago, Ill.—Represented by C. P. Dennett, C. K. Knickerbocker, H. N. Scott, W. A. Bennett, A. A. Hale and G. D. Casgrain.

Grip Nut Co., Chicago, Ill.—Represented by E. R. Hibbard, J. W. Hibbard, W. E. Sharp, Howard Hibbard, Clif Beaumont and B. C. Hooper.

Hale & Kilburn Co., Philadelphia, Pa.—Represented by V. von Schlegell, J. G. Bower, A. F. Old, C. W. Laskay, W. F. Cutler, F. F. Robb, F. C. Edson and R. H. Pilson.

Hammett, H. G., Troy, N. Y.—Represented by H. G. Hammett, E. C. Sawyer and A. O. Van Dervort.

Hardy Paint & Varnish Co., Toledo, Ohio.—Represented by C. J. Pilliod.

Harrington, Son & Co., Edwin, Inc., Philadelphia, Pa.—Represented by Roger Sherron, A. M. Harrington, W. J. Somerset and M. W. Christian.

J. W. Hogsett, Chf. Joint Ins., Ft. Worth & Dallas, Texas.

J. Snowden Bell, Assoc. Member, A. R. M. M.

E. M. Grove, Treas., McConway & Torley Co.

O. C. Cromwell, M. E., Balt. & Ohio, and John D. McClintock, of William Sellers & Co.

Getting Ready to Go Some—W. H. Birchall, John Greismar, C. M. Bigger and Wife.

Lewis Mann, The Fairbanks Co., New York.

D. W. Pye, Pres., Transportation Utilities Co.

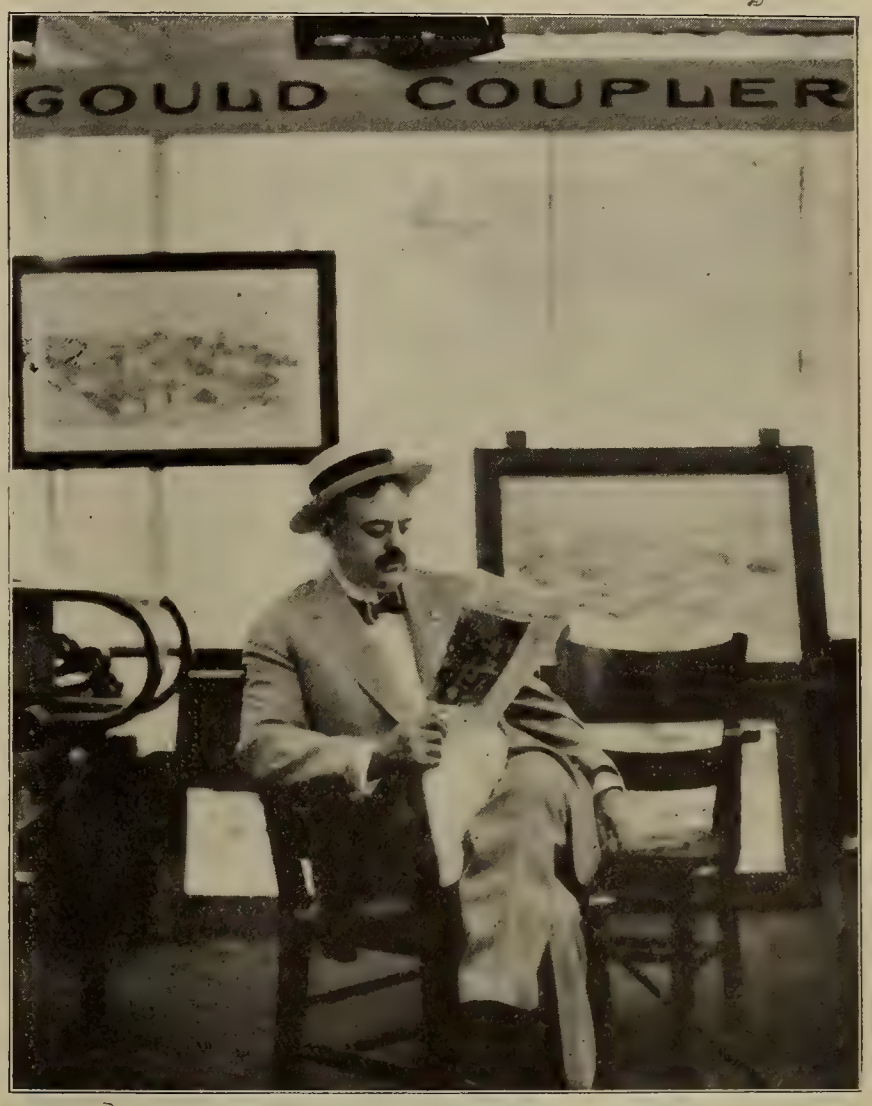
B. E. Bushnell, of Stewart, Hartshorn & Co.

"Happy" Waters, of the Jerguson Mfg. Co.

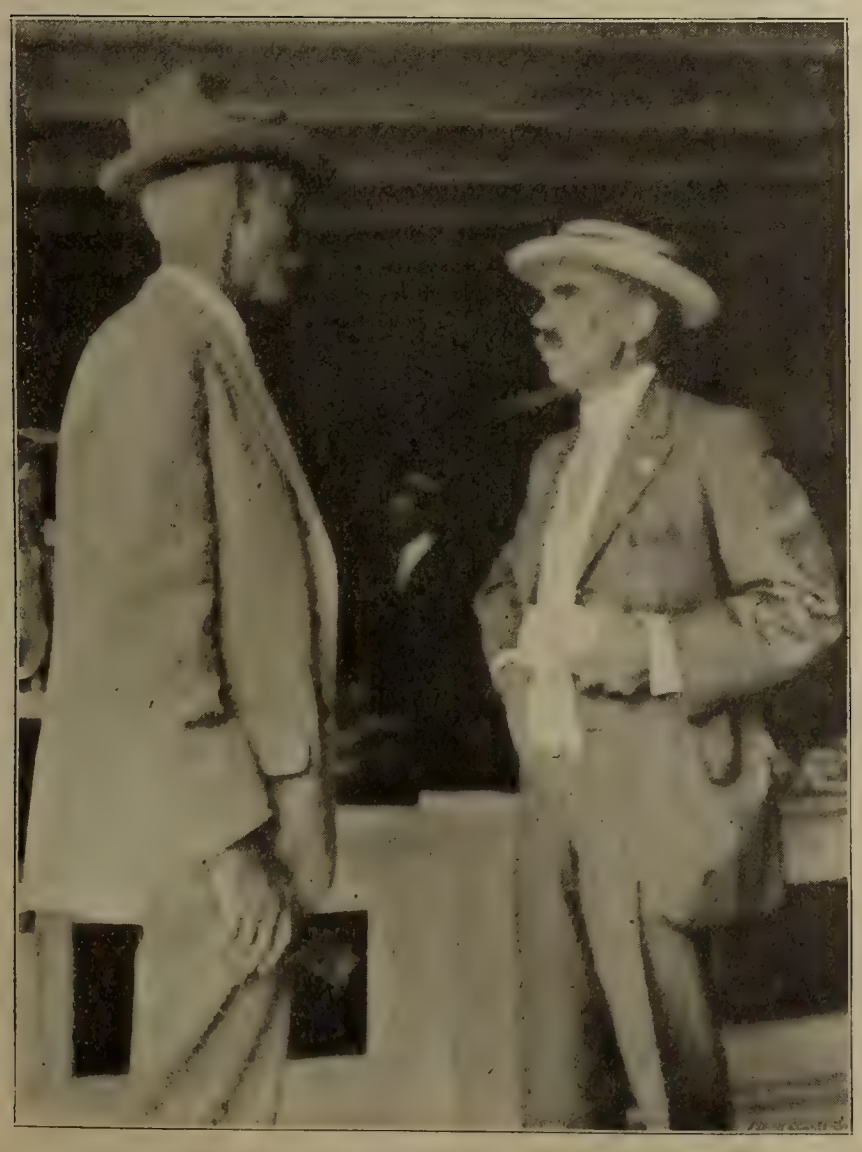
F. W. Miller, of the F. W. Miller Heating Co.

W. H. Lewis, Supt. M. P., N. & W. Ry.; Archibald W. Lewis, Chief Matl. Insptr., N. & W. Ry., and Wife.

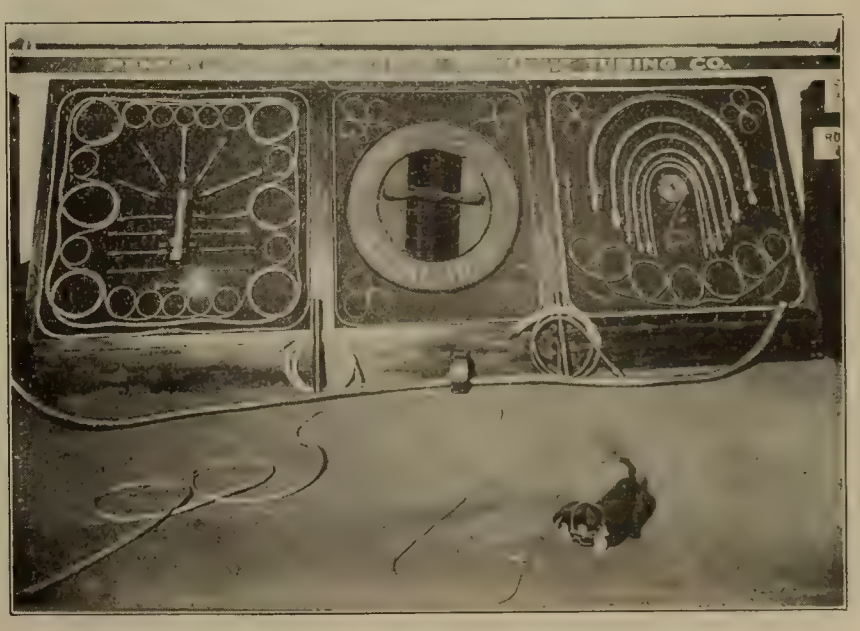
The Booth of William Jessop & Sons, Inc.



F. P. Huntley, V. P., Gould Coupler Co.



Dean Benjamin, of Purdue University, and George L. Fowler.



Booth of Pennsylvania Flexible Metallic Tubing Co.

Joseph Quigley, M. M., C., N. O. & T. P. Ry.

Two of the Oldest and Spriest Men Attending: W. T. Smith, Formerly S. M. P., C. & O., and Geo. S. Allen, Formerly M. M., P. & R.

Standing—H. M. Williams and John C. Knight. Seated—Wm. H. Sauvage and Frank D. Ward.

A Part of B. E. D. Stafford, J. Roger Flannery, James T. Flannery and Tom R. Davis, of the Flannery Bolt Co.

C. E. Smith and T. J. Lawler, American Roll Gold Leaf Co.

S. B. Bechtel and D. A. Corey, of S. F. Bowser & Co.

Hartshorn Co., Stewart, East Newark, N. J.—Represented by B. E. Bushnell.

Heppenstall Forge & Knife Co., Pittsburgh, Pa.—Represented by L. H. Bowman and E. H. Graham.

Hewitt, H. H., New York, N. Y.—Represented by Samuel J. Sill.

Hewitt Rubber Co., New York, N. Y.—Represented by T. D. Hogan and C. M. Bower.

Heywood Bros. & Wakefield Co., Wakefield, Mass.—Represented by E. C. Lang, Bertram Berry and Scot Wade.

Hobart-Allfree Co., The, Chicago, Ill.—Represented by W. H. England, E. H. Allfree, F. R. Cooper and B. F. Hobart.

Hunt-Spiller Manufacturing Corporation, South Boston, Mass.—Represented by W. B. Leach, F. M. Weymouth, J. G. Platt, A. B. Root, Jr., V. W. Ellet, J. M. Monroe and Frederic Parker.

Hutchins Car Roofing Co., Detroit, Mich.—Represented by F. N. Whyte, D. W. Hawksworth, A. R. Wilson, Carter Blatchford and W. D. Thompson.

Illinois Steel Co., Chicago, Ill.—Represented by D. E. Sawyer and O. H. Baker.

Independent Pneumatic Tool Co., Chicago, Ill.—Represented by James B. Brady, John D. Hurley, H. F. Finney, George A. Gallinger, John P. Bourke, H. F. Charabono, R. S. Cooper, Walter A. Johnson, Vernon Job, George J. Lynch, C. B. Ross, R. T. Scott, George C. Wilson, F. J. Passino, H. H. Hendricks, W. R. Gummere, F. W. Buchanan and R. A. Norling.

Inter-locking Rail & Structural Co., The, Chicago, Ill.—Represented by H. C. Farson, Jr., F. A. Bross, J. F. Barnhill, C. V. Mead and W. H. Lienesch.

International Oxygen Co., New York, N. Y.—Represented by E. W. Irwin, A. A. Heller, H. L. Barnitz, I. H. Levin and P. J. Kroll.

Jacobs-Shupert U. S. Firebox Co., New York, N. Y.—Represented by G. H. Pearsall, C. B. Moore and A. W. Whitford.

Jenkins Bros., New York, N. Y.—Represented by Alfred Engle, B. J. Neely and C. B. Yardley, Jr.

Jerguson Manufacturing Co., The, Boston, Mass.—Represented by Geo. L. Huntress, Jr., and Herbert M. Waters.

Jessop & Son, Inc., Wm., New York, N. Y.—Represented by John E. Sandmeyer.

Johns-Manville Co., H. W., New York, N. Y.—Represented by J. E. Meek, J. C. Younglove, G. A. Nicol, P. C. Jacobs, F. J. Horne, J. H. Trent, R. A. Hamaker, H. G. Newman and Geo. Christenson.

Joliet Railway Supply Co., Chicago, Ill.—Represented by E. A. Laughlin, C. F. Huntoon, R. F. Schultz, Jos. F. Leonard and F. A. Lester.

Jones & Laughlin Steel Co., Pittsburgh, Pa.—Represented by Roland Gerry, Robert Geddis, J. K. Barker, Frank S. Slocum, G. B. Mitchell and other representatives.

Joyce-Cridland Co., The, Dayton, Ohio.—Represented by Chas. D. Derby, Russell W. Wallace, W. Irving Clock, F. I. Joyce and Geo. W. Llewellyn.

Justice & Co., Philip S., Philadelphia, Pa.—Represented by Philip J. Mitchell.

Kendrick Improved Valve Company, Globe, Ariz.—Represented by W. D. Kendrick.

Keyoke Railway Equipment Co., Chicago, Ill.—Represented by George C. Murray and Roy J. Cook.

Keystone Drop Forge Works, Chester, Pa.—Represented by Geo. H. Berlin, Chas. F. H. MacLaughlin and William J. McDevitt.

Keystone Lubricating Co., Philadelphia, Pa.—Represented by A. C. Buzby, H. A. Buzby, L. K. Smith, J. N. Mowery and T. O. Organ.

Knight, Inc., John C., New York, N. Y.—Represented by John C. Knight, George P. Smith, Herbert M. Williams, William H. Sauvage and Frank D. Ward.

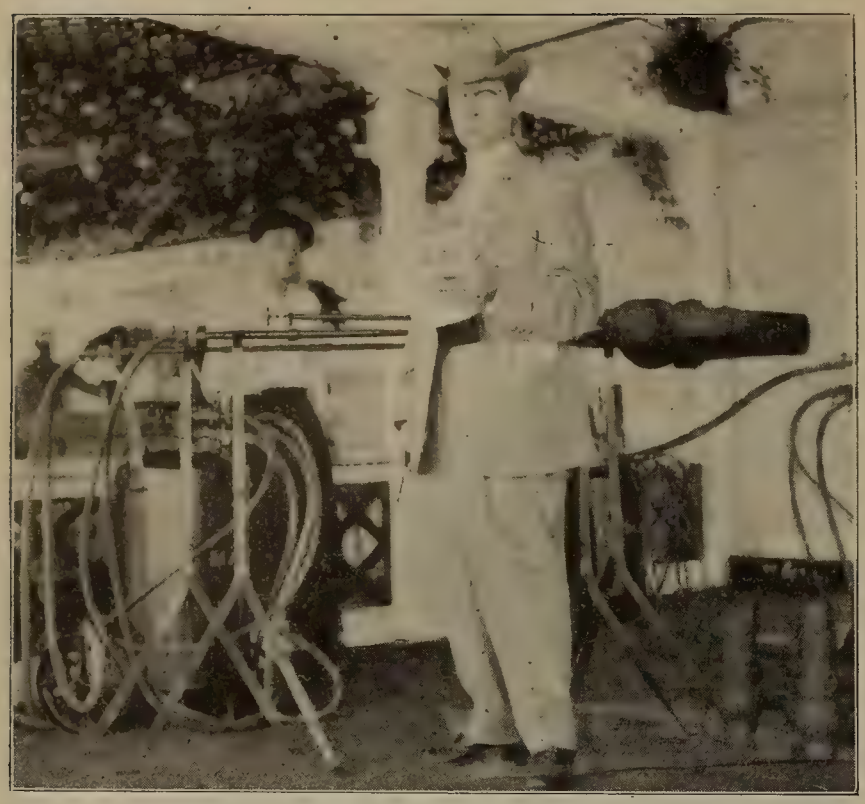
Landis Machine Co., Waynesboro, Pa.—Represented by Carl F. Meyer, J. W. Willis and J. G. Benedict.

Landis Tool Co., Waynesboro, Pa.—Represented by T. H. King, Ralph Forthman and W. G. Nevin.

A Bunch in the Booth of the Franklin Railway Supply Co.—Barry Mohun, J. A. Costello and Geo. L. Weiss.

J. E. Sandmeyer, E. M. Britton and O. H. Reynolds, of Wm. Jessop & Sons, Inc.

Left to Right—F. M. Egolf, Curtain Supply Co.; Geo. E. Fox, Curtain Supply Co.; A. La Mar, M. M., Penn.; C. W. Seddon, S. M. P., D., M. & N.; S. W. Midgley, Curtain Supply Co.; R. F. Hayes, Curtain Supply Co.; W. W. Wilt, Asst. to S. M. P., Penn. L. W.



J. A. Mahr, of the Mahr Fuel Oil Burner Co., Minneapolis, Minn.

C. A. Methfessel, T. A. McGinley and E. A. Johnson, of the Duff Mfg. Co.

A Group at the Coupler Exhibit—C. A. Schroyer, of the North Western, Demonstrating.

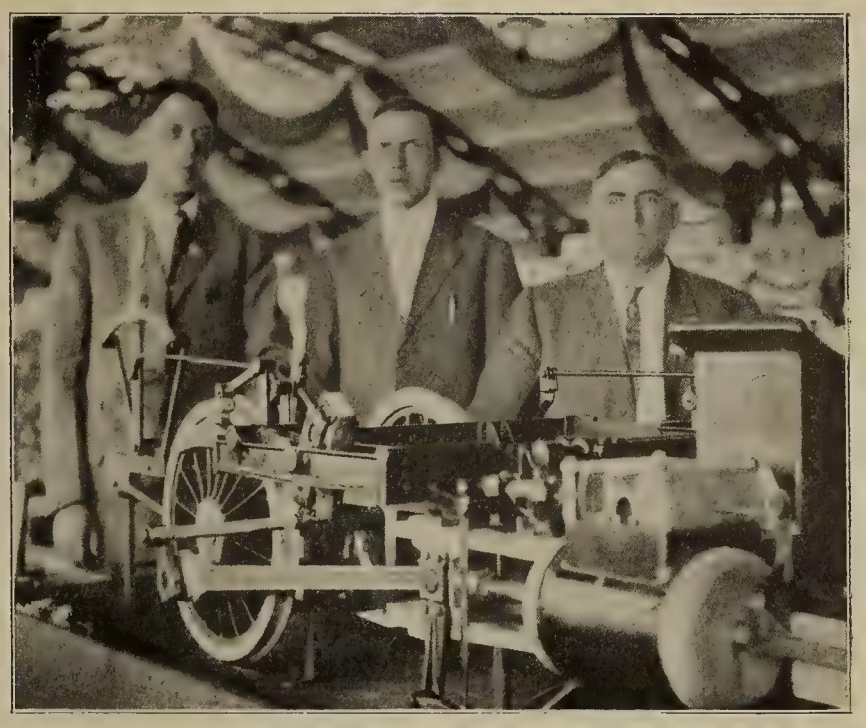
Three Pennsylvania Men—A. La Mar, M. M., Chicago; W. S. Carey, Chf. Clerk to G. S. M. P.; C. F. Thiele, Genl. Car Ins.

H. Chamberlain, H. H. Schroyer, Acme Supply Co.; Mr. Trimyear, and W. L. Crowell, Acme Supply Co.

R. H. Pilson, Chicago Railway Equipment Co.; W. P. Hawley, U. S. Light & Heating Co.

H. W. Schatz, American Tool Works Co.

R. L. Mason, of Hubbard & Co.



Geo. A. Hartman, C. A. Rehklau and Chas. J. Pilliod, of the Standard Valve Gear Co.

J. D. Conway, Sec., Ry. Supply Mfrs'. Assn.

Robt. S. Alter, Sec., American Tool Works Co.

F. Francis and Son F. B., W. T. Kramer and W. T. Dunning, of the Chester Steel Castings Co. and Industrial Supply & Equip. Co.

D. R. McBain, S. M. P., L. S. & M. S.

W. H. Hall, Chf. Car Ins., Cent. of New Jersey.

R. Cooley and Geo. Cook, Chicago Car Heating Co.; T. Dunbar, Acme Supply Co., and J. F. Oelerich, Genl. Ry. Supply Co.

J. F. O'Connor, Miner & Co.; J. P. Williams, Pratt & Letchworth; W. E. Robertson, Miner & Co., and A. L. Harris, M. D. T., Rochester, N. Y.

J. L. Stark, of the Chicago-Cleveland Car Roofing Co. and an Active Member of the Chief Interchange Ins. & Car Fmns. Assn.

J. S. Sheafe, Engr. Tests, Ill. Cent., and Mrs. Sheafe.

W. K. Krepps, of the Crucible Steel Co., and Son Kinsman.

J. A. Pilcher, M. E., N. & W.

W. P. Hawley, V. P., U. S. Light & Heating Co.

Lea-Courtenay Co., Inc., New York, N. Y.—Represented by C. R. Rothwell, Albert G. Lea and J. B. Danolds.

Lehon Co., The, Chicago, Ill.—Represented by Tom Lehon.

Liberty Manufacturing Co., Pittsburgh, Pa.—Represented by H. A. Pastre and W. A. Darrow.

Locomotive Stoker Co., New York, N. Y.—Represented by W. S. Bartholomew, Clement F. Street, N. M. Lower, F. J. Philbrick, O. B. Capps and R. J. Himmelright.

Locomotive Superheater Co., New York, N. Y.—Represented by Geo. L. Bourne, R. M. Ostermann, Gilbert E. Ryder, F. C. Schaff, H. B. Oatley, N. T. McKee, W. A. Buckber and W. G. Tawse.

Lodge & Shipley Machine Tool Co., The, Cincinnati, Ohio.—Represented by J. Wallace Carrel.

Lucas Machine Tool Co., Cleveland, Ohio.—Represented by W. L. Cheney, J. A. Leighton, Jr., and F. P. Sprague.

Lunkenheimer Co., The, Cincinnati, Ohio.—Represented by Lane Thompson and A. S. Phillips.

Lutz-Webster Engineering Co., Inc., Philadelphia, Pa.—Represented by P. W. Webster.

McClellon Locomotive Boiler Co., Boston, Mass.—Represented by J. M. McClellon and William I. Cantley.

McConway & Torley Co., The, Pittsburgh, Pa.—Represented by Stephen C. Mason, E. M. Grove, Wm. McConway, Jr., H. C. Buhoup and I. H. Milliken.

McCord & Co., Chicago, Ill.—Represented by A. C. McCord, D. W. McCord, Morrill Dunn, J. A. Lamon, R. L. McIntosh, H. S. Whitehair, H. E. Creer and W. J. Schlacks.

McCord Manufacturing Co., Detroit, Mich.—Represented by August W. L. Hartbauer and Benjamin S. McClellan.

McGraw Publishing Co., Inc., New York, N. Y.—Represented by H. M. Wilson, H. W. Blake, F. Kingsley, C. A. Babtiste, W. K. Beard, L. E. Gould, C. A. Henley and J. C. Raymond.

Magnus Metal Co., New York, N. Y.—Represented by W. H. Croft, W. S. Bostwick, F. S. Beal, L. C. Dodd and C. A. Lyons.

Mahr, J. A., Minneapolis, Minn.—Represented by J. A. Mahr.

Manning, Maxwell & Moore, Inc., New York, N. Y.—Represented by A. J. Babcock, James B. Brady, P. M. Brotherhood, J. N. Derby, R. A. Bole, E. D. Garfield, M. A. Sherritt, F. W. Mawby, George E. Neil, R. S. Dean, C. M. Chapman, T. S. Stephens, F. P. Smith, Chas. L. Brown, Jos. H. Bush and John J. Faas.

Mark Manufacturing Co., Chicago, Ill.—Represented by Clarence Mark and J. K. Saville.

Massachusetts Mohair Plush Co., Boston, Mass.—Represented by W. W. Melcher.

Midvale Steel Co., The, Philadelphia, Pa.—Represented by Henry M. Deemer, A. E. Goodhue, C. F. Tietze, M. D. Hayes, W. S. Edger, D. Vincent Foster, G. Aertsen, James Thompson and T. W. Illingworth.

Milburn Co., The, Alexander, Baltimore, Md.—Represented by A. F. Jenkins, C. R. Pollard, Charles H. Holder, J. W. McCauley and L. P. Naylor.

Monarch Steel Castings Co., Detroit, Mich.—Represented by J. S. Stringham, M. B. Gilberson and N. Macdonald.

Moran Flexible Steam Joint Co., Louisville, Ky.—Represented by C. H. Jenkins.

Nathan Manufacturing Co., New York, N. Y.—Represented by Alfred Nathan, Edw. S. Toothe, Otto Best, J. C. Currie, J. S. Seeley, Edw. Laterman.

National Graphite Lubricator Co., The, Scranton, Pa.—Represented by Lewis S. Watres.

National Lock Washer Co., The, Newark, N. J.—Represented by W. C. Dodd, F. B. Archibald, C. P. Williams, D. Hoyt and J. H. Horn.

National Malleable Castings Co., The, Cleveland, Ohio.—Represented by F. R. Angell, Tom Aishton, Chas. A. Bieder, W. E. Coffin, Chas. Gaspar, R. T. Hatch, John H. Jaschka, George V. Martin, J. H. Merrell, Jr., Ben Nields, Jr., J. A. Slater, J. H. Slawson, S. L. Smith, E. O. Warner, G. F. Wilhelmy,

J. S. Seeley, of the Nathan Mfg. Co.

Wm. J. Clark, General Electric Co.

Jack W. Meeks and F. W. Brazier.

W. T. Dunning, Industrial Supply & Equip. Co.

B. S. Johnson and I. O. Wright, of T. H. Symington Co., and Fred Sivyer, Northwestern Malleable Iron Co.

W. J. Caton, of Brown & Co., Inc., and Wife.

Standing—F. A. Barbey, E. T. Sawyer, D. Ahldin, Geo. A. Bryant. Bottom Row—R. J. Faure, H. G. Doran, C. E. Lee (Genl. Mgr.), O. F. Ostby, C. A. McCune.—All of the Commercial Acetylene Ry. Light & Signal Co.

P. P. Mirtz, M. E., L. S. & M. S., and Geo. Davies, Supt. Car Dept., L. S. & M. S.

J. D. Robb and Wife, Mrs. J. M. Robb, Mrs. Frank Robb, Miss Patterson, Mrs. W. B. Leach, J. G. Platt and A. B. Root.

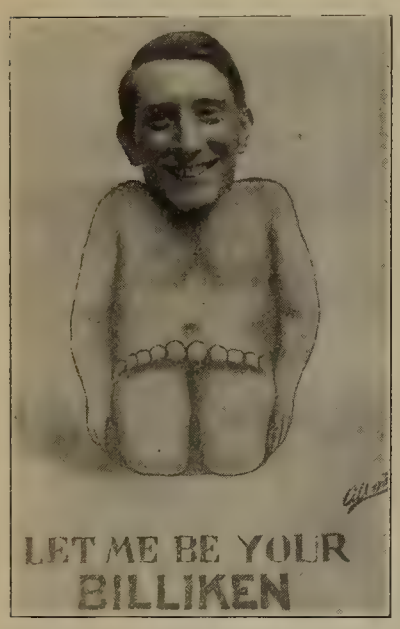
A Group in Front of the Greek Temple Before the Meeting Was Called to Order.

C. H. Andrus, M. M., Penn. R. R., Harrisburg, Pa.

"Clif" Beaumont, of the Grip Nut Co.

Louis Turivas, Asst. to Pres., Great Western Smelting & Refining Co.

C. K. Cairns, American Tool Works Co.



J. C. Hussey, American Tool Works Co.

C. M. Barnes, East. Rep. Anchor Packing Co.

W. A. Scott, Jr., Pres., American Car Screen Co.

H. M. Waters and George L. Huntress, Jerguson Mfg. Co.

E. C. Sawyer, of H. G. Hammett & Co.

W. E. Sharp, Grip Nut Co.

Geo. Bourne, Locomotive Superheater Co., and J. G. Neuffer, S. M. P., Chi. G. W.

Mark Ross, of the Buda Co.

Arnold P. Bark, United Engr. & Fdy. Co.

F. H. Smith, Gold Car Heating & Lighting Co.

F. S. Anthony, S. M. P., Texas & Pacific, and W. B. Hall, Union Ry. Equip. Co.

R. J. Fisher, Bass Fdy. & Mach. Co.

W. A. Bonitz, Sales Manager, American Vanadium Co., and B. D. Lockwood, Chf. Engr., Pressed Steel Car Co.

A. G. Hollingshead, H. L. Winslow and P. W. Dieter.

Thomas B. Arnold, Union Spring & Mfg. Co., St. St. Louis.
Miss Casey, of Indianapolis.
Mr. George Ferrier and Miss Deborah Ferrier, of Moorestown, N. J.
C. E. Postlethwaite, Pressed Steel Car Co.
G. E. Strattan, Inspector of Passenger Equipment, P. R. R.

Standing—H. L. Winslow and C. R. Powell. Seated—P. W. Dieter.

R. C. Totten, with the Nickel Chrome Chilled Car Wheel.

H. G. Hammett.

I. J. Justus, Special Inspector Representing Mr. Brazier on the Coupler Committee, and T. J. Boring representing Mr. Kleine.

C. J. Pilliod representing the Hardy Paint & Varnish Co., of Toledo, as Well as the Standard Valve Gear Co.

The Attractive Booth of the American Roll Gold Leaf Co.

L. S. Wright, O. W. Loomis, E. H. Schmidt and J. J. Byers.

National Tube Co., Pittsburgh, Pa.—Represented by G. N. Riley, P. J. Conrath, J. Kelly, J. T. Goodwin, L. R. Phillips and L. F. Hamilton.

Newhall Engineering Co., George M., Philadelphia, Pa.—Represented by Wm. L. Brown, W. W. Clements, M. I. Newhall, David Newhall and Wm. Waring.

Nickel Chrome Chilled Car Wheel Co., Pittsburgh, Pa.—Represented by Robert C. Totten.

Northwestern Construction Co., New York, N. Y.—Represented by R. C. Wood, W. C. Banks, J. M. Coote and C. W. Scott.

Norton Co., Worcester, Mass.—Represented by E. W. Dodge, George W. Thompson, Charles H. Norton, C. O. Smith, Hiram Cudworth and Carl F. Dietz.

Norton Grinding Co., Worcester, Mass.—Represented by E. W. Dodge, Geo. W. Thomson, Geo. H. Norton, C. O. Smith, Hiram Cudworth and Carl F. Dietz.

Norton, Inc., A. O., Boston, Mass.—Represented by H. A. Norton and J. O. St. Pierre.

Nuttall Co., R. D., Pittsburgh, Pa.—Represented by Milton Rupert and Frank M. Erb.

Okonite Co., The, New York, N. Y.—Represented by J. D. Underhill, F. J. White and W. G. Hovey.

O'Malley-Beare Valve Co., Chicago, Ill.—Represented by Thos. O'Malley and Edward O'Malley.

Oxweld Railroad Service Co., Chicago, Ill.—Represented by G. H. Pearsall, C. B. Moore and A. W. Whitford.

Pantasote Co., The, New York, N. Y.—Represented by John M. High, William A. Lake and Allan S. Barrows.

Parkesburg Iron Co., The, Parkesburg, Pa.—Represented by H. A. Beale, Jr., W. H. S. Bateman, C. L. Humpton, H. C. Hunter, J. A. Kinkead, L. P. Mercer, J. H. Smythe and George Thomas, 3d.

Parsons Engineering Co., Wilmington, Del.—Represented by D. T. Williams, H. Morris, H. K. Mask and J. A. Carey.

Paxton-Mitchell Co., Omaha, Neb.—Represented by Charles A. Coons and W. M. Leighton.

Pearsall Co., The, New York, N. Y.—Represented by G. H. Pearsall and F. H. Gardner.

Pennsylvania Flexible Metallic Tubing Co., Philadelphia, Pa.—Represented by H. A. Ansell, S. H. Collom, Geo. L. MacCabe, O. N. Thornton and P. H. Cumings.

Pilliod Co., The, Swanton, Ohio.—Represented by R. H. Weatherly, F. E. Pilliod, R. G. Graham, F. S. Wilcoxen, C. M. Jennelle and K. J. Eklund.

Pittsburgh Steel Foundry Co., Pittsburgh, Pa.—Represented by H. V. Seth and John Allison.

Pneumatic Jack Co., Louisville, Ky.—Represented by J. S. Leake and Geo. B. Maltby.

Pollak Steel Co., The, Cincinnati, Ohio.—Represented by H. S. Buck, J. A. Pollak, B. E. Pollak, Frank W. Graves, W. L. Jeffries, Jr., B. A. Hegeman, Jr., Chas. C. Castle and Harold Hegeman.

Pressed Steel Car Co., New York, N. Y.—Represented by O. C. Gayley, N. S. Reeder, J. F. MacEnulty, J. H. Regan, C. A. Lindstrom, C. E. Postlethwaite, J. H. Mitchell, L. O. Cameron, J. C. Anderson, J. S. Turner, W. H. Wilkinson, M. S. Simpson, H. S. Hammond, G. W. Ristine, H. H. Gilbert and F. L. Johnson.

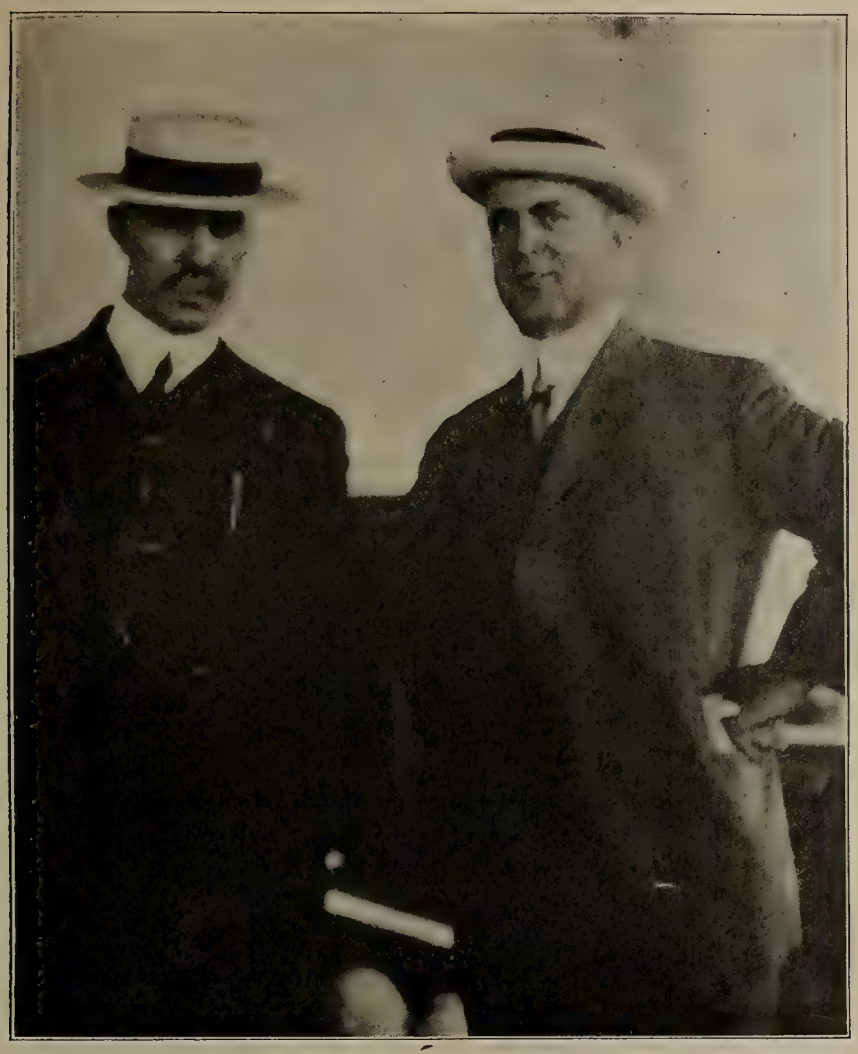
Prince-Groff Co., Camden, N. J.—Represented by Sherman W. Prince, Clarence B. Groff and Benjamin F. Waitt.

Pyle-National Electric Headlight Co., Chicago, Ill.—Represented by R. C. Vilas, Wm. Miller, C. P. McGinnis, J. E. Kilker and J. Will Johnson.

Pyrene Manufacturing Co., New York, N. Y.—Represented by Edward M. Davidson, George H. Peterson and Thomas W. Areson.

Quigley Furnace & Foundry Co., Springfield, Mass.—Represented by A. D. Heyl, A. M. Moyer and W. S. Quigley.

Railway Age Gazette, New York, N. Y.—Represented by E. A. Simmons, S. O. Dunn, Roy V. Wright, E. A. Averill, E. S.

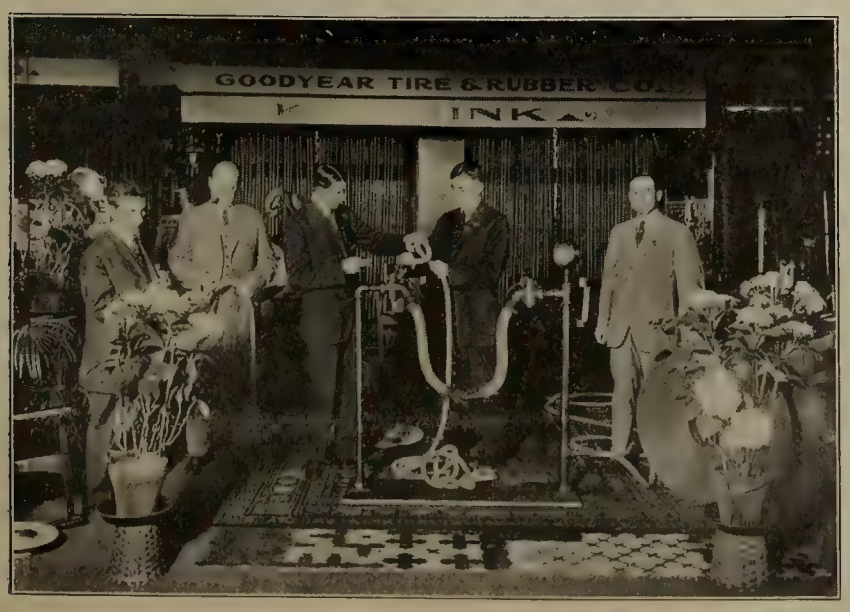


G. J. Duffy, M. M., Lake Erie & Western, and G. E. Parks, New York Central Lines West.

Standing, Left to Right—D. D. Arden, M. M., Savannah & Statesbore R. R.; F. H. Smith, E. R. Wilson (V. P.), A. D. Stuver and F. T. Kitchen. Seated—A. B. Strange, Edward E. Gold (Pres.) and F. A. Purdy. All but Mr. Arden are With the Gold Car Heating & Lighting Co.

C. S. Myers; J. W. Menzies, Clerk U. S. Dist. Court, Covington, Ky.; A. W. Hubbard, Pur. Agt., Andrews Steel Co., and J. M. Crowe. The two in Center Are Survivors of the Naushon Which Was "Wrecked" Off Atlantic City.

Messrs. Snyder and Strecker, of Wiley & Russell Mfg. Co.

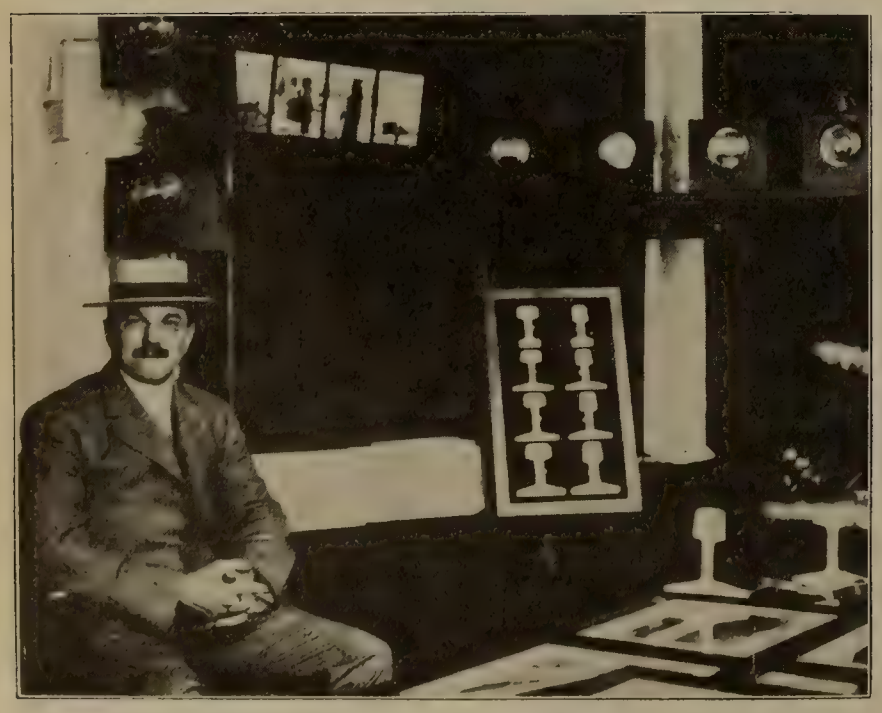


A Bunch Looking Over the New Flexible Hose in the Booth of the Goodyear Tire & Rubber Co., Including F. J. Blake, L. H. Conger and G. D. Pilgrim.

B. E. Bushnell, of Stewart Hartshorn & Co.

Standing—Messrs. Schoaf, Harris, Payne, Strecker and Martin. Sitting—Messrs. Hawks, Seller Judge, Snyder and Hawks. The Wiley & Russell Mfg. Co. Bunch Just After Church.

A. E. Barron and Arthur C. Lewis, of Templeton, Kenly & Co., and W. B. Hall, of the Union Railway Equipment Co.



Sam Simonds and the Frictionless Rail.

Faust, A. C. Loudon, H. F. Lane, F. W. Kraeger, R. E. Thayer, L. B. Sherman, Henry Lee, F. H. Thompson, H. H. Marsh, C. R. Mills, Walter M. Ford, A. F. Ashbacker, W. D. Horton, H. D. Horton, C. E. Holburn, A. Gegen, I. B. Rines, F. S. Dinsmore and L. G. Dennison.

Railway & Engineering Review, The, Chicago, Ill.—Represented by Willard A. Smith, Harold A. Smith, John M. Lammedee, Jos. E. Sample and R. S. Richardson.

Railway Devices Co., St. Louis, Mo.—Represented by Louis A. Hoerr, Sterling Campbell and R. L. Langtim.

Railway Electrical Engineer, Chicago, Ill.—Represented by Edward Wray.

Railway List Co., Chicago, Ill.—Represented by Wm. E. Magraw, Chas. S. Myers, L. F. Wilson, J. M. Crowe, Dalton Risley and O. W. Middleton.

Railway Materials Co., The, Chicago, Ill.—Represented by T. B. Cram, George Hoeffle, E. C. Folsom, Ira B. Lesh and J. F. Schurch.

Railway Utility Co., Chicago, Ill.—Represented by J. P. Gallagher, Lee P. Hynes, Wm. J. Pine, E. J. Magerstat and James Denton.

Ralston Steel Car Co., Columbus, Ohio.—Represented by J. S. Ralston, J. E. Tesseyman, F. E. Symons, A. D. McAdam, J. R. Forney, W. F. La Bonta, C. S. Rea, W. T. Sheldon, M. A. Alexander and C. Vance.

Reed Manufacturing Co., Erie, Pa.—Represented by A. M. Johnston, T. O. Raaen and E. C. Barnett.

Reliance Electric & Engineering Co., Cleveland, Ohio.—Represented by H. M. Hitchcock, E. A. Lewis, S. C. Potter, D. G. Darling and A. W. Ray.

Restein Co., Clement, Philadelphia, Pa.—Represented by Clement Restein, W. J. Cromie, H. O. Fettinger and Norman B. Miller.

Rich Tool Co., Chicago, Ill.—Represented by Russell Dale, J. G. Kirby, O. F. Schubert and J. A. Elmslie.

Richmond Stay-Bolt Drilling Machine Manufacturing Co., Richmond, Va.—Represented by K. H. Carper and J. W. Cregar.

Rochester Germicide Co., Rochester, N. Y.—Represented by C. S. Whitman and C. J. Pearson.

Ryerson & Son, Joseph T., Chicago, Ill.—Represented by E. T. Hendee, G. M. Basford, W. H. Eulass and H. A. Gray.

Safety Car Heating & Lighting Co., The, New York, N. Y.—Represented by R. M. Dixon, A. C. Moore, J. S. Henry, R. C. Shaal, J. A. Dixon, G. E. Hulse, W. I. Thomson, J. H. Rodger, Wm. St. John, M. F. Elliott, L. Schepmoes, C. B. Adams, W. L. Garland and Geo. H. Chadwell.

Safety Steel Ladder Co., St. Louis, Mo.—Represented by Chas. F. Palmer, J. W. Faessler and W. A. Mitchell.

Sargent Co., Chicago, Ill.—Represented by Frank G. Dunbar and George H. Sargent.

Scarritt-Comstock Furniture Co., St. Louis, Mo.—Represented by C. C. Taylor.

Sellers & Co., Inc., Wm., Philadelphia, Pa.—Represented by John D. W. Clintock, Chas. T. Wilson, Edw. L. Holljes, W. W. Storm and Strickland L. Kneass.

Sprague Electric Works, New York, N. Y.—Represented by D. C. Durland, H. W. Uhl, C. J. Johnson and J. A. Clifford.

Standard Asphalt & Rubber Co., Chicago, Ill.—Represented by Chas. V. Eades.

Standard Car Truck Co., Chicago, Ill.—Represented by F. L. Barber, James T. Milner, H. M. Edgerton and Lee W. Barber.

Standard Heat & Ventilation Co., Inc., New York, N. Y.—Represented by George B. Culver, J. F. Deems, Peter Fink, Frank N. Grigg, W. G. Hermsen, Charles E. Lowell, Rolland B. Lowther, C. E. Miller, C. F. McCuen, Lewis B. Rhodes, E. C. Post, Walter B. Van Beuren, John E. Ward and A. L. Whipple.

Standard Improved Truck Co., Chicago, Ill.—Represented by D. P. Jennings and F. A. Guilford.

Standard Roller Bearing Co., Philadelphia, Pa.—Represented by J. G. Cooley and M. G. Sperzel.

T. J. Lawler, American Roll Gold Leaf Co., and G. W. Rink, M. E., Cent. of New Jersey.

W. S. Bostwick, Magnus Metal Co., and H. F. Lowther, Pur. Agt., D. L. & W. Ry.

L. S. Wright, O. A. Bieder, J. H. Jaschka and T. W. Aishton, of the Natl. Malleable Castings Co.

D. J. Lewis and Robt. Morton, of Natl. Graphite Lubricator Co.

Fred Atwater, Treas, and Fred C. Dunham, Spec. Sales Agt. of the Columbia Nut & Bolt Co.

Wm. H. Armstrong, Ingersoll-Rand Co.

P. A. Bevan and George T. Ramsey, of the American Vanadium Co.

Norman C. Einwechter, Colonial Steel Co.

G. W. Greenwood, Acme Machinery Co.

W. S. Rose, New York Rep. W. L. Brubaker & Bros.

H. V. Seth and John Allison, Pittsburgh Steel Foundry Co.

P. L. Rhodes, Sales Mgr. Homestead Valve Mfg. Co.

Robert Patterson, of the Grand Trunk, and Gertrude Patterson.

Standard Steel Car Co., New York, N. Y.—Represented by J. B. Brady, R. L. Gordon and H. G. Macdonald.

Standard Steel Works Co., Philadelphia, Pa.—Represented by Robert Radford, W. H. Pugh, Jr., Charles Riddell, C. H. Peterson, Fred W. Weston, A. Roy Green, Wm. B. Keys and Wm. F. Boyer.

Standard Stoker Co., Inc., Wilmington, Del.—Represented by J. A. Carey and D. T. Williams.

Standard Valve Gear Co., The, Toledo, Ohio.—Represented by Frank Harrison and George H. Hartman.

Steel Specialties Co., Boston, Mass.—Represented by Albert L. Cole and Geo. Louis Richards.

Storrs Mica Co., Owego, N. Y.—Represented by Charles P. Storrs.

Symington Co., The T. H., Baltimore, Md.—Represented by C. J. Symington, W. W. Rosser, T. C. deRosset, R. H. Gwaltney, I. O. Wright, S. L. Kamps, A. H. Weston, D. F. Mallory and B. S. Johnson.

Templeton, Kenly & Co., Ltd., Chicago, Ill.—Represented by Alfred E. Barron, Arthur C. Lewis and Walter B. Templeton.

Titanium Alloy Manufacturing Co., The, Niagara Falls, N. Y.—Represented by A. C. Hawley and Chas. Vickers.

Transportation Utilities Co., New York, N. Y.—Represented by D. W. Pye, W. L. Conwell, H. B. Chamberlain and G. Burgert.

Underwood & Co., H. B., Philadelphia, Pa.—Represented by H. D. Griffith, D. C. Hitchner and C. O. Ralph.

Union Draft Gear Co., Chicago, Ill.—Represented by J. R. Cardwell, L. T. Canfield, J. W. Hathaway, W. G. Krauser and J. E. Tarelton.

Union Railway Equipment Co., Chicago, Ill.—Represented by W. B. Hall.

Union Spring & Manufacturing Co., Pittsburgh, Pa.—Represented by L. G. Woods, A. M. McCrea, Chas. S. Foller, Henry B. Darlington, W. F. LaBonta, A. C. Woods, T. B. Arnold, H. F. Ayres and Joseph Wood, Jr.

U. S. Light & Heating Co., The, New York, N. Y.—Represented by J. Allan Smith, A. H. Ackermann, Wm. P. Hawley, W. L. Bliss, Wm. G. Davis, R. S. Bryan, John A. White, C. C. Bradford, L. N. Talkes, W. F. Bauer and W. A. Turbayne.

U. S. Metal & Manufacturing Co., New York, N. Y.—Represented by B. A. Hegeman, Jr., C. C. Castle, F. C. Dunham, E. D. Hillman, H. A. Hegeman, H. K. Porter and E. R. Shoenberger.

U. S. Metallic Packing Co., The, Philadelphia, Pa.—Represented by Morris B. Brewster, John S. Mace, Clarence L. Mellor, Harry M. Wey and Elliott Curtiss.

United Engineering & Foundry Co., Pittsburgh, Pa.—Represented by Arnold P. Bark.

Universal Draft Gear Attachment Co., Chicago, Ill.—Represented by C. J. Nash and C. C. Kinsman.

Valentine & Co., New York, N. Y.—Represented by Langdon B. Valentine, Irving H. Munford and C. W. Rhoades.

Van Dorn Co., W. T., Chicago, Ill.

Virginia Equipment Co., Toledo, Ohio.—Represented by Lacey Y. Williams, John S. Acklin, Grafton A. Dodd and Harold G. Williams.

Vixen Tool Co., Philadelphia, Pa.—Represented by Walter D. Craft, R. H. Anthony, C. M. Zubler and James C. Barr.

Warner & Swasey Co., The, Cleveland, Ohio.—Represented by H. E. Witham, R. G. Buyer and C. J. Stilwell.

Waterbury Tool Co., The, New Britain, Conn.—Represented by H. G. Hoadley, Reynold Janney, R. B. Day and W. W. Marshall.

Watertown Specialty Co., Watertown, N. Y.—Represented by C. E. Miser and Lewis de L. Berg.

Watson Stillman Co., The, New York, N. Y.—Represented by R. Baker, F. H. Clark, R. R. Harrison, P. R. Ketzer, E. A. Stillman, A. F. Stillman, G. R. Smith, F. T. West and C. Wigtel.

Welsbach Co., Gloucester, N. J.—Represented by Charles W. Wardell.

West Disinfecting Co., New York, N. Y.—Represented by Geo. L. Lord and H. E. Daniels.

Western Railway Equipment Co., St. Louis, Mo.—Represented by Louis A. Hoerr, S. H. Campbell and R. L. Langtim.

Western Steel Car & Foundry Co., New York, N. Y.—Represented by O. C. Gayley, J. F. MacEnulty, J. H. Regan, C. A. Lindstrom, N. S. Reeder, C. E. Postlethwaite, J. H. Mitchell, L. O. Cameron, J. C. Anderson, J. S. Turner, W. H. Wilkinson, M. S. Simpson, H. S. Hammond, H. H. Gilbert, F. L. Johnston and G. W. Ristine.

Westinghouse Air Brake Co., Pittsburgh, Pa.—Represented by A. L. Humphrey, E. A. Craig, S. J. Kidder, C. R. Ellicott, F. V. Green, J. B. Wright, W. V. Turner, J. R. Ellicott, C. P. Cass, F. M. Nellis, Robt. Burgess, E. L. Adreon, C. J. Olmstead, C. C. Farmer, T. L. Burton and T. R. Brown.

Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa.—Represented by J. C. McQuiston, H. W. Beaumont, H. C. Mode, E. M. Wise, W. H. Patterson, R. F. Moon and R. E. S. Geare.

Westinghouse Lamp Co., Pittsburgh, Pa.—Reception booth. Represented by A. C. Wade, B. Hayllar, Jr., and B. F. Fisher, Jr.

Westinghouse Machine Company, The, Pittsburgh, Pa.—Represented by E. H. Sniffin, H. A. Rapelye, L. L. Brinsmade and E. D. Kilburn.

White Enamel Refrigerator Co., St. Paul, Minn.—Represented by K. G. Anderson and Frank Gilmore.

Wheel Truing Brake Shoe Co., Detroit, Mich.—Represented by J. M. Griffin.

Wiener Machinery Co., New York, N. Y.—Represented by F. H. Scantlebury and Richard B. Fraken.

Wiley & Russell Manufacturing Co., Greenfield, Mass.—Represented by F. O. Wells, F. W. Strecker, F. H. Hoffman and G. W. Snyder.

Wilmarth & Morman Co., Grand Rapids, Mich.—Represented by Chas. E. Meech, Jos. H. Hazley, B. C. Saunders and E. T. Gorham.

Wilson Remover Co., Newark, N. J.—Represented by J. Mac Naull Wilson and James Whitney Wilson.

Winslow Co., Horace L., Chicago, Ill.—Represented by Horace L. Winslow, R. Powell and A. G. Hollingshead.

Wood, Guilford S., Chicago, Ill.—Represented by D. P. Jennings and F. A. Guilford.

Yale & Towne Manufacturing Co., The, New York, N. Y.—Represented by C. W. Beaver, A. W. Patterson, Jr., W. A. Hall, W. C. Miner, W. C. Bigelow, H. H. Ricketts and J. F. Stoldt.

Zug Iron & Steel Co., Pittsburgh, Pa.—Represented by George W. English.

Robt. Weatherly, The Pilliod Co.

C. E. Fuller, A. G. M., U. P., and J. H. Bendixen, The Bettendorf Co.

Among The Manufacturers

ELECTRIC WELDING IN THE LOCOMOTIVE SHOP.

The term "electric welding" is applied in a general way to results obtained by various methods and a variety of means, whereby sufficient heat is generated through a resistance of electrical current either by direct contact, or by the arc flame or arc fusion, to reduce metals to a molten state uniting two or more members by amalgamation or welding.

Indianapolis Shop Welding Outfit.

Of the methods of electric welding, there may be mentioned the spot or soak welding wherein the parts to be welded are interposed between the electrical poles with sufficient current and pressure to unite at a welding heat; the method of electric welding by means of the carborn arc flame on low and varying voltage and high potential, the arc or flame being directed on or against the parts to be welded until the surface is brought to a welding heat; and a new system described below. The new method is a means of welding with the metal electrode which constitutes the welding material and which is fluxated steel, iron or other metal of proper and varying constituency and size averaging $\frac{3}{16}$ or $\frac{1}{4}$ in. in diameter. Suitable electrical current is passed through the welding machine, adapted and regulated according to the nature of the work and passed through a flexible cable to which is attached an insulated welding handle or head holding the metal electrode which is the positive. The part to be welded or added to, being the negative.

To start the welding, the electrode is placed in contact and withdrawn just a sufficient distance to form a short arc which makes a pocket or cavity in the negative member and at the same time deposits therein and thereon a molten globule of the electrode which action is continuous until the electrode is melted down. The molten metal follows the direction of the current uniting by "first intention" making a perfect amalgamation of the metals, and without disseminating undue heat. This is very essential particularly in the filling in of key-seats, building up worn bearings and tapers of armature or commutator shafts, without removing the shaft or injuring the winding.

The outfit is known as the "Indianapolis Portable Electric Welder" and while in the course of development for several years past, was only brought out commercially in November, 1912, being primarily intended for use on street railways for reclaiming worn and broken track work, rolling stock or power plant equipment, but through its adaptability and wide range of use, it is now also in extensive use in rolling mills, iron works and industrial plants for repairs, and since this process requires no preparation other than connecting with electrical current, it has proved most convenient in repairing broken locomotive parts without the necessity of removal and without stopping or interfering with other operations.

As to the cost of this method or process: the electrods or welding steel, ranges in cost from 5c to 15c per pound. All of the steel is utilized and the total amount required varies from a few ounces, in most instances, to a few pounds, making the cost of the welding material practically nothing and as the work is rapidly done, the time feature does not enter largely into the cost. The electric current, of course, depends somewhat upon the cost of generating and the source of supply, it would average from 50c to $1.00 per hour for continuous service but it is seldom used over a few minutes continuously and in most plants, equipped with electrical current, the current necessary for handling all of the welding required is within the reserve or excess volume available and will not run to the above figures. For instance, a large locomotive shop operating one of these welders and making a careful tabulation of the total cost of the repair work, including material, time of the operator, the current and overhead, made a total of an average of 1c per minute. But in every instance the entire cost is said to be so small compared with the results obtained that it barely admits of discussion or mention.

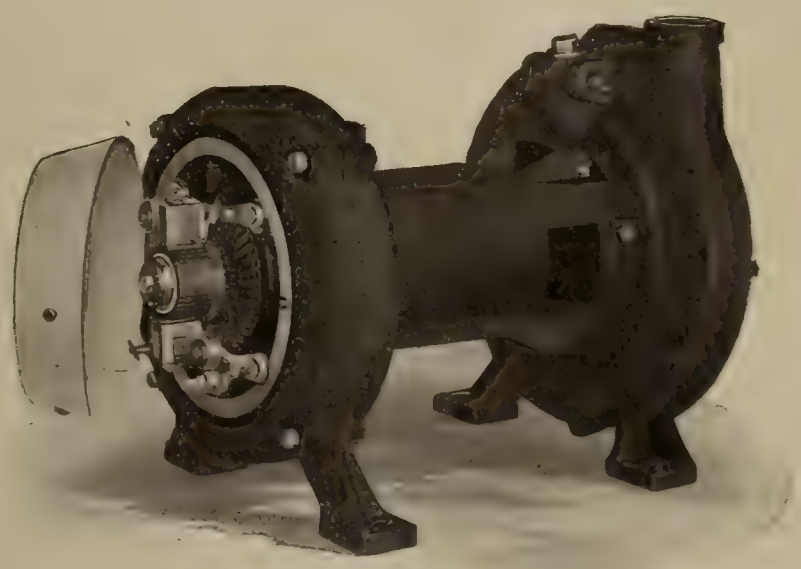
The outfit is shown in the accompanying illustration. It is manufactured by the Indianapolis Switch & Frog Co., Springfield, Ohio.

PYLE NATIONAL "TYPE E" HEADLIGHT SET.

The plant of the Pyle National Electric Headlight Co., Chicago, has been developed to a high state of efficiency which merits unusual attention. In this factory only electric headlights with the necessary generators and accessories are produced. So complete is the equipment of the shop, however, that no parts are purchased outside for assembly.

J. E. Kilker, superintendent of the shops, has applied many methods which were developed by him and others while he was assistant superintendent of Silvis shops of the Chicago, Rock Island & Pacific Ry. Particular attention has been given to automatic machinery in the manufacture of the small parts for the turbines and generators of the headlight sets. Greatly increased capacity has been obtained by slight changes in the design of these parts so that the number of operations in turning them out could be reduced. Nearly all operations are done on the piece-work system and a great deal of thought is evident in the jigs and templates used in the machine work. The inspection is so carefully maintained as to insure accuracy in the completed machine.

The latest type of headlight set is illustrated herewith: It is known as "Type E" and has proved very successful in



Pyle National Type "E" Turbo Generator.

service. It operates on steam in pressures from 100 lbs. upwards. The rotor turns at 2800 R. P. M.

The dynamo is of a bi-polar internal magnetized type with the neutral point fixed so that no sparks should be seen at the brushes. The armature is held in place on the turbine shaft by one screw, which can be easily taken out if occasion demands. The brush-holders are fixed, and the brushes can be taken out and replaced without changing the tension of the springs.

The turbine wheel is made from cast steel and has but one row of buckets. The buckets are accurately made from drawn steel, reinforced and securely dovetailed in outer periphery of wheel. The wheel is forced with a taper fit on the shaft and locked by means of a washer and nut. The governor weights and spring are attached as a unit with the wheel.

But two bearings are used in the outfit. One of these bearings is of a special annular ball type. The bearing for the generator is located in the barrel on end of main casting. The bearing supporting the turbine wheel is mounted in the turbine cap. This bearing is of the sleeve ring oiling type, and is made of a special bronze bearing metal. Either of the bearings can be removed easily and within a few minutes' time. Lubrication, which is required only by the bearings, is accomplished by two oil cups in which a heavy oil should be used.

The governor is of a special tension spring type, located on the wheel, operating the valve by means of two levers; the tension of the spring is set for the desired speed (2800 R. P. M.) before leaving the factory.

It is creditable to the Pyle-National Electric Headlight Co. that the headlight legislation which has been enacted in many states has not been made with its assistance. On the contrary, in several instances, the advice of officers of this company has prevented radical steps in legislatures which if carried through would have made any but electric headlights illegal. This is in line with a far-sighted policy of placing the electric headlight only where service conditions warrant.

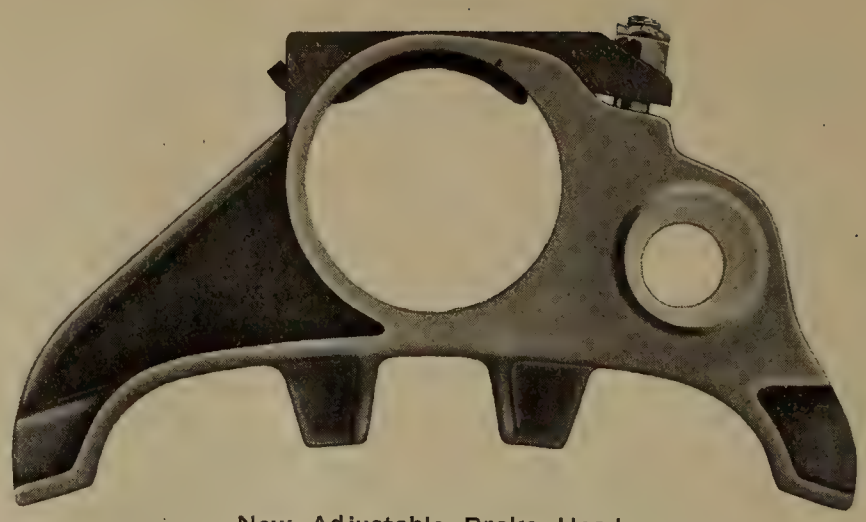
A RAILWAY SPECIAL WATCH DIAL.

A watch dial specially designed for railway officers has been placed on the market by L. B. Ferguson, master mechanic of the New Orleans & Northeastern, who is responsible for the design.

The feature of the dial is the arrangement of the dial marking, the minutes appear in large figures on the outer circumference of the dial while the hours are shown in smaller figures on the inner dial, to farther facilitate easy and accurate reading the hour figures and the hour hand are colored red. The usual second hand on a small dial is located at the bottom of the watch face. In reading the dial the railway man is first concerned with the minutes as the hour is known. It is for this reason that the minute figures are made as plain and large as possible. Operating officers will find this dial easy of application to any standard watch and will be pleased with the effect. The Ferguson Dial Co., of Monroe, La., is the manufacturer.

ADJUSTABLE BRAKE HEAD.

The illustration shows the new adjustable brake head of the Buffalo Brake Beam Company, designed to meet the requirements of a brake head in connection with brake beams for modern high speed passenger equipment. The adjustment feature of the head commends itself on account of its simplicity, accessibility and minimum parts. The adjustment is controlled by a cast steel lock at the back of the head, having the same contour on its bearing surface as the sleeve. By the contact of the steel lock against the sleeve, the head is held firmly and rigidly at the angle prescribed by the seating of the brake shoe, the force of contact being controlled by tightening the nut on the bolt at the top of the head. The location of the adjustment



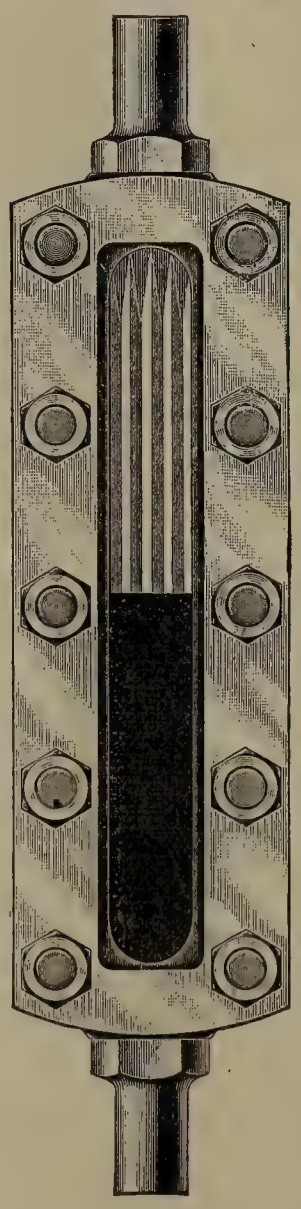
New Adjustable Brake Head.

lock bolt at the top of the head is such that any adjustment in the angle of the head can be made, or any wear between the head and sleeve can be taken up while the beam is in service.

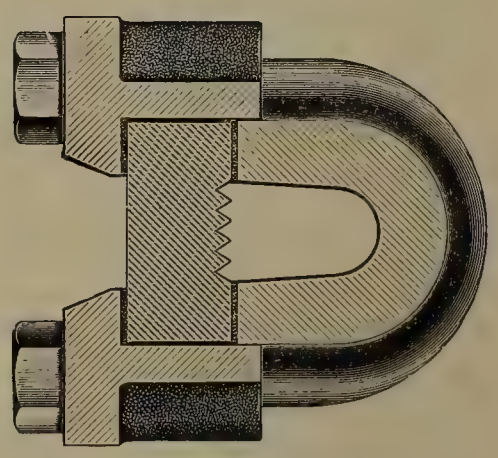
IMPROVED KLINGER TYPE WATER GAGE.

Klinger gages, which are recognized as standard by a number of railways, consist of front and back frames with the glass between. These parts are clamped together with bolts which pass through outturning flanges of the rear frame and screw into the front frame of the gage. This type of frame is unsatisfactory in service because of (1) the inherent weakness in the design; (2) the method employed for clamping the parts, which makes it difficult for the average mechanic to set up the bolts evenly on the glass and gasket; (3) the excessive labor cost of making repairs.

Uneven setting up of the bolts, together with the weak design of the frames, causes buckling and distortion of these parts, and leakage around and breakage of the glasses result. This type of construction, however, has one decided advantage;



Elevation of New Klinger Gage.



Cross Section New Klinger Gage.

that is, it permits the vital parts of the gage to be exposed for repairs without the necessity of removing the entire gage from the boiler fittings, as is the case with various freakish substitutes on the market.

In the design of the improved gage the manufacturer retains the advantageous features and eliminates the weak points of the standard Klinger type by changing the form of the frames and employing an entirely new method of clamping the parts together, as will be noted by referring to the cross section shown. With the U-shaped back is provided a frame that is a deep and continuous truss at the sides the entire length of the gage, and a rigidity, otherwise unattainable, is secured. The front frame also differs materially in form from existing types and is considerably stronger and more durable.

The means employed for clamping the glass and gasket between the frames is entirely new, practical, simple and most efficient. The bolts are die formed to fit around the back frame, pass the side of the glass and through the front frame and setting up of the bolts is done evenly and tightly in front of the gage, where there is plenty of room to work. The bolts are close to the sides of the glass, and clamping pressure, which is wasted in other gages, is utilized where it is needed most—on the gasket.

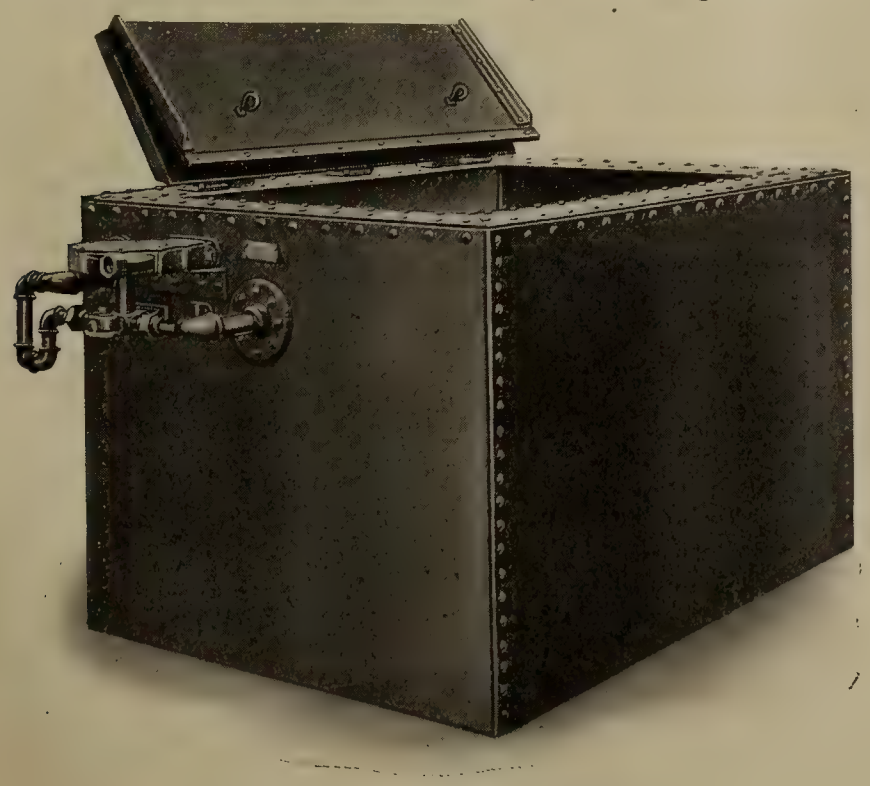
With the form of frames used in this improved gage and the method employed for clamping the parts, buckling or distortion of the frame is eliminated and renewals of glass and gasket, through breakage and leakage, is reduced to a minimum. Owing to the simplicity of construction the labor cost of making repairs is considerably reduced. Another saving effected with the improved gage is in the renewals of clamping bolts. In some types the bolts are frequently twisted off or lost while making repairs, but in the improved gage the size and form of the bolts eliminates this expense entirely.

The manufacturer of this gage is the Jerguson Gage & Valve Co., 88 Broad street, Boston, Mass.

NEW QUENCHING TANK FOR OIL TEMPERING.

The process of heat treatment has developed so greatly in the last few years that it has become necessary to develop equipment for tempering to keep in line with its progress in other directions, particularly in regard to furnaces. It is just as necessary to have the quenching oil kept within commercial limits of temperature as it is to have furnaces that heat uniformly.

In spring manufacturing there has come into practice comparatively recently the use of alloy steels which require more careful and uniform heat treatment than the carbon steels require. To the improvement not only of heating devices in connection with the treating of steel, but also the subsequent quenching devices, the American Shop Equipment Co., McCormick Building, Chicago, has directed its attention.



New Oil Quenching Machine.

The quenching machine illustrated herewith consists of two tanks, an inner and an outer; a cooling coil in the space between the two tanks, and a water motor direct connected to a rotary pump. The inner tank contains the quenching oil. One end of the pipe coil is flanged to the upper part of this inner tank, and the other end of the pipe coil connects to suction end of pump. The discharge end of pump connects to the lower part of the inner tank, and the oil is thus drawn off from the top of the tank, circulated through the cooling coil and discharged into the bottom of the inner tank. The waste water from the water motor flows into the space between the two tanks and surrounds the coils and overflows from an opening in the top of the outside tank to a sewer or cistern. It is necessary to have at least twenty pounds of water pressure to operate satisfactorily. The machine is semi-automatic inasmuch as the motor and pump speed depends entirely on the water admitted to the motor, under valve control, of course.

These tanks are built in several different standard sizes and have worked out in practice very satisfactorily in heat treating equipments and spring tempering plants, and appears to have solved the problem of keeping quenching oil at a uniform temperature in installations where a large and elaborate circulating cooling device is impracticable.

Industrial Notes

The Locomotive Arch Brick Co. has taken over the patents and business of the Fire Clay Development Co., 1201 Chamber of Commerce building, Chicago, Ill. The company has recently been organized with the following officers: President, J. W. Moulding; vice-president, E. P. Stevens; vice-president and general manager, John L. Nicholson; secretary, T. C. Moulding. The Moulding family has been in the fire brick business since 1861, and now owns five large modern plants, for which the Locomotive Arch Brick Co. will be the selling agents.

The National Railway Equipment Co., Toledo, Ohio, has been incorporated with a capitalization of $10,000 by Charles Weirich, Frank W. Caughling and others, to manufacture locomotive parts and other railroad equipment.

F. T. Hyndman, formerly with S. F. Bowser & Co., Inc., has been appointed superintendent of motive power of the Wheeling & Lake Erie.

E. H. Outerbridge, who has been secretary and treasurer and managing director of the Pantasote Co., New York, since its organization, has been made a vice-president and managing director of that company. Raymond Harvey, who has been associated with Mr. Outerbridge for more than ten years, has been made secretary and treasurer of the same company.

The good will, drawings, patterns and patents of the Rockwell Furnace Co. have been purchased by the Quigley Furnace & Foundry Co., Springfield, Mass., which concern will continue the manufacture of the full line of furnaces, with the exception of the melting furnaces, portable heaters, rivet forges, etc., which will be marketed by the Monarch Engineering & Mfg. Co., Baltimore, Md., it having added the Rockwell melting line to its present line of furnaces. Orders for repair parts, etc., will be given prompt attention by these companies.

The Northwestern Construction Co. has removed its New York office from 50 Church street to room 318, 30 Church street.

George L. Hall, vice-president of the Q. & C. Co., New York, died in that city on June 1, at the age of 46. Mr. Hall was born at Bedford, Pa., on February 25, 1867.

A. C. Moore, general manager of the Safety Car Heating & Lighting Co., New York, has been made vice-president of that company, with office in Chicago. Mr. Moore will have entire charge of the western business of the company.

Personals

J. Miller has been appointed general foreman, locomotive department of the Burnside shops of the Illinois Central at Chicago.

R. O. Prendergast succeeds Hugh Montgomery as mechanical superintendent of the Bangor & Aroostock, with office at Milo Junction, Me.

W. H. Scribner has been appointed supervisor of mechanical examinations of the Lake Shore & Michigan Southern, with office at Cleveland, O. He will have charge of examination of locomotive firemen.

H. H. Stephens has been appointed master mechanic of the Atchison, Topeka & Santa Fe at Wellington, Kan. He succeeds H. Schaefer, transferred to Clovis, N. M.

F. T. Hyndman has been appointed superintendent of motive power of the Wheeling & Lake Erie, with office at Leader-News building, Cleveland, O. Mr. Hyndman was formerly with the railroad department of S. F. Bowser & Co.

G. A. Gibson succeeds H. G. Cross as roundhouse foreman of the Central Vermont at White River Jct., Vt.

F. E. Wees has been appointed general foreman of the Ann Arbor at Frankfort, Mich. He succeeds Wm. McKendrie.

W. W. Griswold has been appointed purchasing agent of the Wheeling & Lake Erie, with office in the Perry-Payne building, Cleveland, O., succeeding J. F. Marshall, resigned to accept service with another company.

J. F. Marshall succeeds E. S. Wortham as manager of purchases and supplies of the Chicago & Alton, with office at Chicago.

H. E. Jones has been appointed assistant superintendent of the Denver & Salt Lake, the office of superintendent having been abolished. Mr. Jones' headquarters are at Fraser, Colo.

W. L. Thomas succeeds J. R. McMullin as master mechanic of the Cananea Consolidated Copper Co.'s Ry. with office at Cananea, Son., Mexico.

W. H. Dyer has been appointed master mechanic of the Georgia & Florida, with office at Douglas, Ga.

T. J. Lynch has been appointed general superintendent of the Greenwich & Johnsonville, with office at Greenwich, N. Y.

E. W. Heugst succeeds P. G. Woods as master mechanic of the Cleveland, Painesville & Eastern. His office is at Willoughby, O.

Ernest Menzie has been appointed superintendent of the Syracuse & Milford, with office at Syracuse, Ind.

A. Benham has been appointed general manager of the Ohio Electric, with office at Springfield, O.

J. S. Beyer has been appointed master mechanic of the Augusta Southern succeeding E. Fuller, with office at Charleston, S. C.

E. Ford has been appointed superintendent and purchasing agent of the Groveton, Lufkin & Northern, with office at Groveton, Tex.

F. Ritner succeeds Geo. Conrad as master mechanic of the Cincinnati, Georgetown & Portsmouth, with office at Cincinnati, O.

A. G. Armstrong has been appointed master mechanic of the Atchison, Topeka & Santa Fe, Coast Lines, with office at Needles, Cal. He succeeds N. P. Cheney.

C. B. Daily has been appointed master mechanic of Chicago, Rock Island & Pacific, with office at Cedar Rapids, Ia., succeeding F. W. Williams, transferred to Manly, Ia.

P. Linthicum succeeds C. B. Daily as assistant superintendent of the Silvis, Ill., shops of the Chicago, Rock Island & Pacific.

O. S. Beyer, Jr., succeeds P. Linthicum as general foreman of the Chicago, Rock Island & Pacific at Horton, Kan.

J. H. Beggs has been appointed purchasing agent of the Chicago & Eastern Illinois, with office at Chicago, succeeding T. J. Powell.

F. S. Schorndorfer has been appointed general foreman of shops of the Baltimore & Ohio Southwestern, with office at Chillicothe, Ohio, succeeding J. G. Hyson, resigned.

M. K. Barnum, formerly general superintendent of motive power of the Illinois Central has been appointed general mechanical inspector of the Baltimore & Ohio. His office is at Baltimore, Ohio.

Geo. S. McKee has been appointed superintendent of motive power of the San Antonio & Aransas Pass, with office at San Antonio, Texas.

C. A. Henry has been appointed superintendent of shops of the Chicago, Burlington & Quincy at West Burlington, Ia., succeeding J. A. Carney.

J. A. Carney has been appointed superintendent of the Aurora shops of the Burlington, vice A. Forsyth, deceased.

Geo. S. Goodwin has been promoted to mechanical engineer of the Rock Island Lines in charge of locomotive design, with office at Chicago.

E. G. Chenoweth has been appointed mechanical engineer of the Rock Island Lines in charge of car design, with office at Chicago.

G. O. Huckett has been appointed master mechanic of the Chicago, Burlington & Quincy, with office at Sterling, Colo., vice H. M. Barr, resigned.

F. G. Glover succeeds F. E. Hutchison as electrical engineer of the Rock Island Lines, with office at Chicago.

THE MAN WHO FAILS.

The man who fails is the sort of a chap
Who is always looking around for a snap;
Who neglects his work to regard the clock;
Who never misses a chance to knock.

He is grouchy and slow when work begins;
When it's time to quit, he jokes and grins;
He's always as busy as busy can be,
When he thinks the boss is around to see.

He believes that a "pull" is the only way
By which he can ever draw bigger pay;
And he sulks and growls when he sees his plan
Upset by the "push" of another man.

He's on the job when he draws his pay;
That done, he soldiers his time away;
While the men who tackle their jobs with vim
Keep pushing and climbing ahead of him.

For the man who fails has himself to blame,
If he wastes his chances and misses his aim;
He'd win, if he'd use his hands and wits:
The man who fails is the man who quits.

—Pere Marquette Monthly Magazine.

The Missouri, Oklahoma & Gulf has awarded contracts for new shop buildings at Muskogee, Okla. The main building for machine shops, blacksmith, boiler and locomotive shop is to be 148x200 feet. Other buildings will include car repair shed, 46x180 feet; carpenter shop, 32x38 feet; store room, 80x52 feet; all of brick and steel construction, estimated cost of $200,000.

The Southern Pacific, it is reported, contemplates the erection of a $40,000 passenger and freight station at Morgan City, La.

POSITION WANTED—A live wire with long experience in railway supply business wants work for a portion of his time. Address A. M., care of Railway Master Mechanic.

RAILWAY MASTER MECHANIC

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Established 1878

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Tools.

A refreshing statement was that of a manufacturer of boiler repair tools, to the effect that his best tools were used by the railways because the industrial shop operators would not pay the price. A tube expander can be made to stand the punishment of working over five to ten thousand boiler tubes, yet the average expander is worn out after service in a few hundred tubes. The high service tool, therefore, saves its cost many times over.

It is a well known fact that interviews with most manufacturers of equipment which is used by railways and for industrial purposes as well, almost invariably result in statements not in accordance with that of the boiler tool man. Many have found that the lowest bid, regardless of quality, will secure the railway business.

Why, then, the exception in the case of boiler tools? It is a question worthy of consideration. This disheartening monotony with which scoop shovels, track tools, and even intricate machinery are purchased on first cost alone is to be deplored. Perhaps the methods of the master boiler maker in securing at higher prices tools which will give ten times the service of those a few dollars cheaper, might be studied and applied by other sub-department heads.

Convention Attendance.

There are some ten or twelve associations in which railway mechanical men are more or less interested. The two oldest and most influential organizations, the American Railway Master Mechanics' and Master Car Builders' Associations, have memberships of respectively 1,074 and 879, while one of the youngest associations, the Railway Tool Foremen's Association, has a membership of 92. The latter is a small membership but at its last convention it had about 50 in attendance, or over 50% of its members, which is a larger percentage of members in attendance than was shown by any other organization during the past year. It is notable that only 36% of the members of the Master Mechanics' and Master Car Builders' Associations attended the recent conventions at Atlantic City, although of course a great many railway men were in attendance as special guests; in fact, more than the total number of members of both associations. The Atlantic City conventions, however, were undoubtedly successful, although it is possible that if they were held elsewhere there would be a larger percentage of members attending. Another association of the same age as that of the tool foremen is the International Fuel Association, which is in its fifth year and has a membership of 590; 47% of its members attended the last meeting. The General Foremen's Association has 214 members and at the recent convention had about 65 in attendance, or about 30%, which is the lowest percentage of any association this year.

Now the reason for the low attendance at the general foremen's convention was not the meeting place, for Chicago is a central location and always draws a good attendance at conventions, as may be attested by the increased attendance and interest at the Traveling Engineers' conventions since they have been held there. The officers of the general foremen are as hard working and as energetic as those of any association, but they cannot make an association in themselves. The field covered by the association is one of the most important in the mechanical department and cannot be covered too fully. The

general foreman is a man who comes directly in contact with the various details of shop work and if there is one place where the interchange of ideas is beneficial, it is in shop practices. Ideas gained at a meeting of this association can be taken home and be made to show in dollars and cents. The problems which it handles may be more detailed than those of the Master Mechanics' Association, but this is its opportunity; to handle the questions which that association has not the time to deal with. There are at least six hundred general foremen in the country, to say nothing of foremen and others who are interested in the general foreman's work, and it does seem that this convention should draw a larger attendance. Its failure to do so must be due to a lack of interest on the part of general foremen, both members and non-members and a lack of encouragement on the part of higher officials.

Every general foreman should make an effort to attend these conventions, and should take along blue prints and descriptions so as to be prepared to tell the members about the way which he has found to do certain operations quicker and cheaper. There has been too much of a tendency to let a few men do the work in this association. Mechanical officials should give those under them more encouragement to attend these conventions, for it will add to the efficiency of their shops and to the efficiency of the men who are in line for promotion. The general foremen are our future shop superintendents and master mechanics. It is to be hoped that this important association will have at least double the attendance at its meeting in 1914, which will probably be held at Chicago.

Howard Elliot.

For the second time in their respective careers Howard Elliot succeeds Charles S. Mellen as the president of a large railway system. In each case the desirability of a complete change of executive policy has been the impelling motive in the selection of Mr. Elliot. Two men of more widely different dispositions, yet with the qualifications of a railway president, could scarcely be found.

As to the results of the application of the Mellen policies in New England there is little to say. He is recognized as a most efficient organizer, a most confident exponent of what he believes to be right, and a most arbitrary executive in putting into effect his personal wishes. Whether on account of, or in spite of these characteristics, he leaves active railway service in New England a most cordially hated man.

The position of the railway executive is becoming year by year more difficult. The public is, at best, fickle in its attitude toward an important individual and the tactful and frank executive could probably have carried out all of Mr. Mellen's policies and still have held the good will of the people. The necessity for taking (or at least seeming to take) the public into his confidence in all matters pertaining to the operation of a great railway, is hard for a representative of the "old school" to realize.

Mr. Elliot is wonderfully successful in holding this good will in every move. His statements are gems of diplomacy and by his methods he is enabled to give the public larger pills to swallow than the arbitrary man could ever hope to "put over."

It is with great pleasure that we note Mr. Elliot's expressed intention of making no changes in his department heads until the absolute necessity of such action becomes evident. A statement of one of the directors of the New Haven system, before the selection of Mr. Elliot, was to the effect that a thorough cleaning out of the present officers was contemplated. This move would have been as foolish as many others which collectively have placed the road in ill repute. Doubtless there will be changes but, if we judge rightly, they will take place only after Mr. Elliot has had opportunity to pass judgment on the qualifications of the present incumbents as he finds them.

The Safety Movement.

R. C. Richards, of the Chicago & North Western, has recently issued a statement of results gained through the comprehensive campaign of safety inaugurated on his system several years ago. Far seeing officers who authorized the expenditure of what may have been considered comparatively large sums in safety education of employes are amply rewarded by the showing presented.

During the three years ending June 30, 1913, and based upon the number of accidents occurring during the year ending June 30, 1910, there was a decrease in the number of employes killed of twenty-eight per cent, and in the number of injured of twenty-four per cent. In the total number of persons killed, including employes, passengers and outsiders there was a decrease of twenty-one per cent. In the same classification the number of injured was reduced twenty-four per cent.

It is probable that a part of this showing should be credited to the adoption of safety appliances not attributable to the safety first movement. Nevertheless there can be no doubt but that the startling results represent an almost direct return on the safety first policy of the management, and the end is not yet. The efforts thus far are merely preliminary. The movement will grow as the men are further educated in the necessity for the use of great care and the elimination of the element of chance.

Box Car Construction.

The report of the Master Car Builders' Committee on Car Construction is to be submitted to letter ballot for adoption as recommended practice, and it is probable that it will carry. The subject of car construction is one which the association has not given the attention it should during the past few years, and C. A. Schroyer at the recent Atlantic City meeting said that if the association did not appoint a standing committee on car construction it would not be many years before the Federal government would do what has been done with regard to safety appliances. It is certain that the American Railway Association will soon call upon the Master Car Builders for a standard design of box car, and it will be well for it to be prepared. The building of cars to withstand present operating conditions is probably one of the most distressing questions in the mechanical field today, and the committee report referred to recognizes this in specifying a greater center sill area for all cars to be built after 1913.

The report also recommends either the steel or the steel reinforced end. The steel end has proved its worth during the past few years, not only from the standpoint of resisting the strains placed upon it, but from the standpoint of economy, and will probably play an important part in future car construction. How-

ever, the entire question of car construction should be gone into just as thoroughly as was the coupler problem.

COLLEGE PROFESSORS WORK IN SHOPS.

Believing firmly in a closer co-operation between industrial and educational institutions, to the advantage of both twenty-eight college professors, representing the electrical engineering departments of twenty-six colleges are spending their vacations working side by side with the skilled mechanics and engineers of the Westinghouse Electric & Manufacturing Co. at East Pittsburgh.

By taking this course the professors are aiming to accomplish a fourfold object: to obtain a firsthand working knowledge of the methods of practical electrical engineering; to secure the opinions of successful engineers and manufacturers on the qualifications of men needed in industrial work, so that they may be taught accordingly and thereby be properly qualified for succeess in their chosen branches; an exchange of teaching ideas among themselves; a study of the industries of the Pittsburgh district.

Many of these professors are heads of the departments in their respective schools and the average length of time spent in teaching is five and one-quarter years.

The professors are employed on the regular shop pay roll and conform to shop hours and regulations, receiving therefor a compensation of 22 cents per hour, or an average of $55 per month; the regular rate for second year apprentices.

The Westinghouse Electric & Manufacturing Co. is a warm supporter of this movement of co-operation between the industrial and educational institutions, and has delegated its highest officials and engineers to meet with the professors and explain to them the work of the various departments of the big electric works, each phase being explained by an expert in his line.

At the close of working hours in the evening these student-workmen, without stopping for dinner, get a lunch of sandwiches and coffee and proceed on a trip of inspection through the works, guided by shop foremen and superintendents, ending in a meeting for discussion of the points covered on the trip.

College professors are usually lacking in practical knowledge of works management and efficiency methods, and it is hoped by this course to gain such a knowledge from close contact with such work and the men who direct it.

At the evening meetings lectures are given by engineers, works managers, foremen, and also educators from their own crowd and the educational institutions of the Pittsburgh district.

In such meetings and by close association with one another for a period of several weeks ideas are obtained and fully developed that prove of immense advantage in furthering the work in which they are engaged, that is, teaching electrical engineering.

Twenty Years Ago This Month

The Safety Car Heating & Lighting Co., seems to have been alarmed at the rumors of danger in the use of their car lighting system. It issued a circular containing the following: "The safety of our system having been anonymously assailed and persistently misrepresented through the scattering of untruthful and misleading circulars, we beg to submit the following": The statement then calls attention to the fact that the use of Pintsch gas is no longer an experiment, that 200 gas plants and 500,000 lamps are used to light 54,000 cars.

Waldo Marshall, now president of the American Locomotive Co., twenty years ago editor of the *Railway Master Mechanic*, had this to say in the August, 1893, issue of this publication: "Railroads that have spent many of Uncle Sam's depreciated silver dollars in fitting their passenger equipment with safety appliances, will learn with dismay that these are about to be superseded by an invention in which the ends of cars are to be on the level instead of square, and the cars held together by additional couplings, springs, etc. In collision the cars cannot telescope, each will simply slide by the one in front of it with a movement similar to that which soldiers execute when they change from single file to so many abreast, the abnormally curious passenger who happens to be in the last car will appreciate the arrangement, for when the collision occurs he will find himself abreast the engine in a twinkling and can see just what was hit." Mr. Marshall's sarcasm, needless to say, proved justified.

The Mason Regulator Co. issued a catalog worded in old English style which seems to have made a hit.

The J. A. Fay & Egan Co. was successful in getting two free notes in the August, 1893, issue of the *Railway Master Mechanic*. Possibly there was more encouragement in the methods of journalism of two decades ago.

A method of obtaining power from the axle of a car to drive an electric lighting dynamo was being tried out by both the Pullman Palace Car Co. and the Central of New Jersey. Power was transmitted through countershafts by sprocket wheels and the speed was regulated by Evans friction cones.

The Air Brake Inspectors' Association was organized at Pittsburgh with the following officers: Robert Burgess, L. & N., president; C. C. Palmer, M., K. & T., vice-president; T. J. Carney, M., L. S. & N., secretary, and Otto Best, N., C. & St. L., treasurer.

The National Engineering Congress was opened in Chicago, July 31, 1893, for a six days' session.

Piston valves as applied to a new Pennsylvania compound locomotive were giving a great deal of trouble and the practice of applying them was criticized caustically by a number of the best motive power authorities. The balanced slide valve was looked upon by these persons as being the only practical system for both simple and compound engines.

THE BUFFALO, Rochester & Pittsburgh Railway is inaugurating the "safety first movement," the services of Geo. Bradshaw, safety engineer, of Highland, N. Y., having been secured to make safety inspection and report on a part of its property and to deliver illustrated lectures to its employes. Many large meetings of its officers and employes have been held in the interest of safety and much interest is manifested.

VOCATIONAL EDUCATION IN CONNECTION WITH RAILROAD WORK.*

By W. L. Park, V. P., Illinois Central R. R.

The dedication of a great temple to learning is no uncommon event, yet no human mind can fathom its possibilities, or the effect upon millions yet to be. To railroad men as well as others the contemplation of this magnificent edifice can only open to their minds a vague conception of the influence to be thrown out from here. The results to be achieved by those who will pass through the portals of this modern Transportation building, equipped with that special knowledge which whets the appetite for the accomplishment of new things yet to be created, cannot be estimated. New methods that will herein be created will bestow upon mankind blessings that ever continue to burst from the fruits of progressive civilization.

The practice of a decade ago, which confused our minds with its ingenuity, sinks today without comment into the commonplace or is rejected as primitive. We have come to expect great things as a matter of course, and perhaps we have a right to do so when we make the path of knowledge so attractive by our great institutions of investigation, research and accomplishment.

We, as railroad men can, without any great prophetic vision, discern something of that which will be the fruit of this modern railroad school. Our experiences of the past teach us that there are yet and near many short cuts; not to perfection but to more

* An address delivered at the Railway Conference held in connection with the dedication of the Transportation Building, the Locomotive Laboratory and the Mining Laboratory at the University of Illinois, May 8 and 9, 1913.

economic methods of both supervision and practice that are essential to our progress and the prosperity of the nation, through the efficient and economical operation of our great railroads.

We fully realize that in many particulars their operation is far short of that to be desired. As we grope into the mysteries of unworked problems we learn of our deficiencies and are appalled at our shortcomings. We have gone so fast in the formative periods of construction that we have lost sight of the refinements of the service.

The magnitude and ingenuity of the great progressive achievement of our railroads has been so wonderful and the results so beneficial and far-reaching that we have, to a great extent, lost sight of the necessity of economizing; we must now take cognizance of the terrific waste and crude methods, and begin to apply the scientific methods.

We must bring about a better system of activities before we have wasted our birthright of natural resources. This power of efficiency must come out of institutions of this character—with their equipment for experimentation and ability to explore the world for knowledge and to make it available to the student.

I would not deprecate in any way all that is intended by these great schools of special training. There are too few of them and those that do exist are frequently restricted in their accomplishment by lack of funds to do all that the faculty have in mind.

I would, however, impress upon those who are responsible for the future prosperity of our railroads the importance of maintaining a proper balance in the human equation—we must not forget the thousands in the ranks who are deprived of the very rudiments of learning upon whom we must yet continue to place great responsibilities. The knowledge, concentrated in our educational institutions, should be made available in some degree at least to those deprived of the advantages until there comes a time of more equal opportunities; some system of education yet to be evolved that will give to those seeking knowledge of this vocation, an opportunity while employed in a gainful occupation, to acquire it.

It may yet be possible for some, who have no means, to work their way through our colleges and technical schools. If others are not dependent upon them for the daily bread and butter this is perhaps possible. There are now, and always will be, however, those who through circumstances entirely beyond their control, are deprived of such opportunities. They must not be overlooked; it is essential that the intelligence of the rank and file of our railroads shall rise with the intelligence of the supervision, if we are to obtain the full benefit of such great institutions as we have dedicated here today.

There must be vocational education of those who are to continue at the throttle; who decide in a flash questions of safety; those who carry the great responsibilities of the conductor, brakeman or switchman must be given opportunities to advance in mentality as such responsibilities grow. The agents and operators must not be confined to the dull routine of their duties. They have time to acquire knowledge and capacity for increased responsibilities; they are hungry for information.

The men in the shops and on the track carrying heavy responsibilities of safety and economy desire to learn and advance and should be assisted and encouraged.

When we recall to mind how difficult it is at times to obtain certain information with all the advantages of a great city or college, we should have some conception, vague though it may be, of the conditions surrounding an operator, towerman or section foreman isolated almost as if on a lonely island by the environments of their occupation.

We have, on the Illinois Central, taken cognizance of these conditions. That there is much eager demand for greater knowledge of their chosen profession through such avenues, is evidenced by the thousands who are availing themselves of the opportunities presented by the educational bureau. That it raises the plane of intelligence there can be no doubt—that it enables some who have the requisite talent and genius, to advance, is evidenced by the recorded results. Employes who have ambition are using the educational bureau as a stepping stone to more advanced positions.

The apprentice in the shop, if his circumstances will permit, can attend the high school and learn his trade at the same time, or he can devote his entire time to his employment, and receive special instruction not only in the trade but in general knowledge.

There is no branch of the service it does not reach—no employe it cannot help. The work like any genuine uplift, is not manifest as some might unreasonably expect, in spontaneous loyalty. There is a leavening, however, of the personnel which must produce results—an irresistible tendency to grow in mentality in spite of our surroundings and obstacles, that no influence, disloyalty, shiftlessness or idle frivolity can control. Were it otherwise, railroad men have indeed sunken to a pitiful condition.

The time will never come to me when I shall willingly withhold the helping hand to those who through heart-breaking restrictions, are deprived of the opportunities vouchsafed to their more fortunate fellow beings, to acquire the knowledge that will make their life work more easy and their advancement possible.

It is not the history of great achievements that it is absolutely essential that the foundation of knowledge must be laid within palatial walls of learning. Railroad managers and educators must be broad enough to grasp the situation as it is. They must not deprecate learning acquired in other than conventional ways; they must assimilate the theoretical and technical with the practical and the superficial.

All the technical knowledge of the world cannot grasp a critical situation to prevent an impending railroad accident. The most learned professors cannot navigate a ship across the seas. The unlearned wireless operator becomes the most important human being among scholars, scientists, statesmen and business experts, in an emergency at sea.

In conclusion, in fear of being misunderstood as deprecating the value of special and technical knowledge, I desire to reiterate the sentiment that I have previously expressed. To those who devote themselves to the work of imparting such knowledge, we as railroad men, owe a deep sense of gratitude. The specialist in railroad work is double-welcome, as the field is broad and practically unfurrowed. We must depend upon the technical graduate for the substantial and permanent betterment of our transportation facilities.

WHERE THE WEST BEGINS.

Out where the hand clasps a little stronger,
Out where a smile dwells a little longer,
That's where the West begins.
Out where the sun's a little brighter,
Where the snow that falls is a trifle whiter,
Where the bonds of home are a wee bit tighter,
That's where the West begins.

Out where the skies are a trifle bluer,
Out where friendship's a little truer,
That's where the West begins.
Out where the fresher breeze is blowing,
Where there is laughter in every streamlet flowing,
Where's there's more of reaping and less of sowing,
That's where the West begins.

Out where the world is in the making,
Where fewer hearts with despair are aching,
That's where the West begins.
Where there is more of singing and less of sighing,
Where there is more of giving and less of buying,
And a man makes friends without half trying—
That's where the West begins.

—*Exchange.*

Mikado Locomotive, P. & R. Ry.

The locomotive shown in the illustration was designed by the mechanical department of the Philadelphia & Reading Railway and built at its Reading shops in September, 1912. It is claimed to be the largest Mikado type locomotive ever built, and the first one constructed to burn fine grades of anthracite coal mixed with a small proportion of bituminous. It has operated in certain kinds of service with straight buckwheat coal, and, in heavy grade service, with a mixture of from four to six portions of buckwheat to one portion of bituminous.

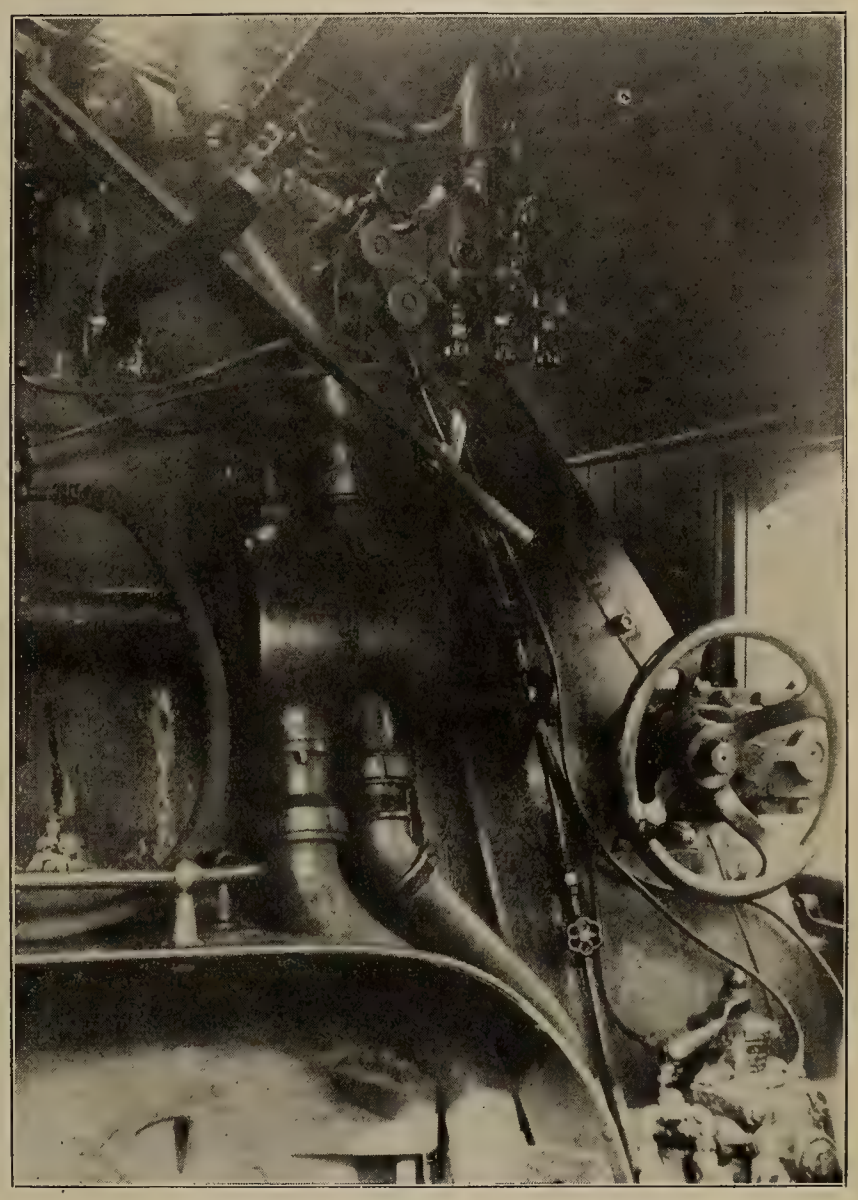
The engine is built with the Walschaert valve gear, which allows very strong cross-bracing between the frames. The frames are very heavy on account of having had considerable trouble with frame breakages, and the mechanical officials of the Reading believe they have in this locomotive a stronger frame construction than in any engine thus far built.

The cylinders are built in three sections with inside admission piston valves. Exceptionally large exhaust ports are provided through the cylinder castings, and outside steam pipe connections of large capacity are used. This makes a very free moving locomotive, with little or no back pressure, the engine moving itself on 30 pounds of steam.

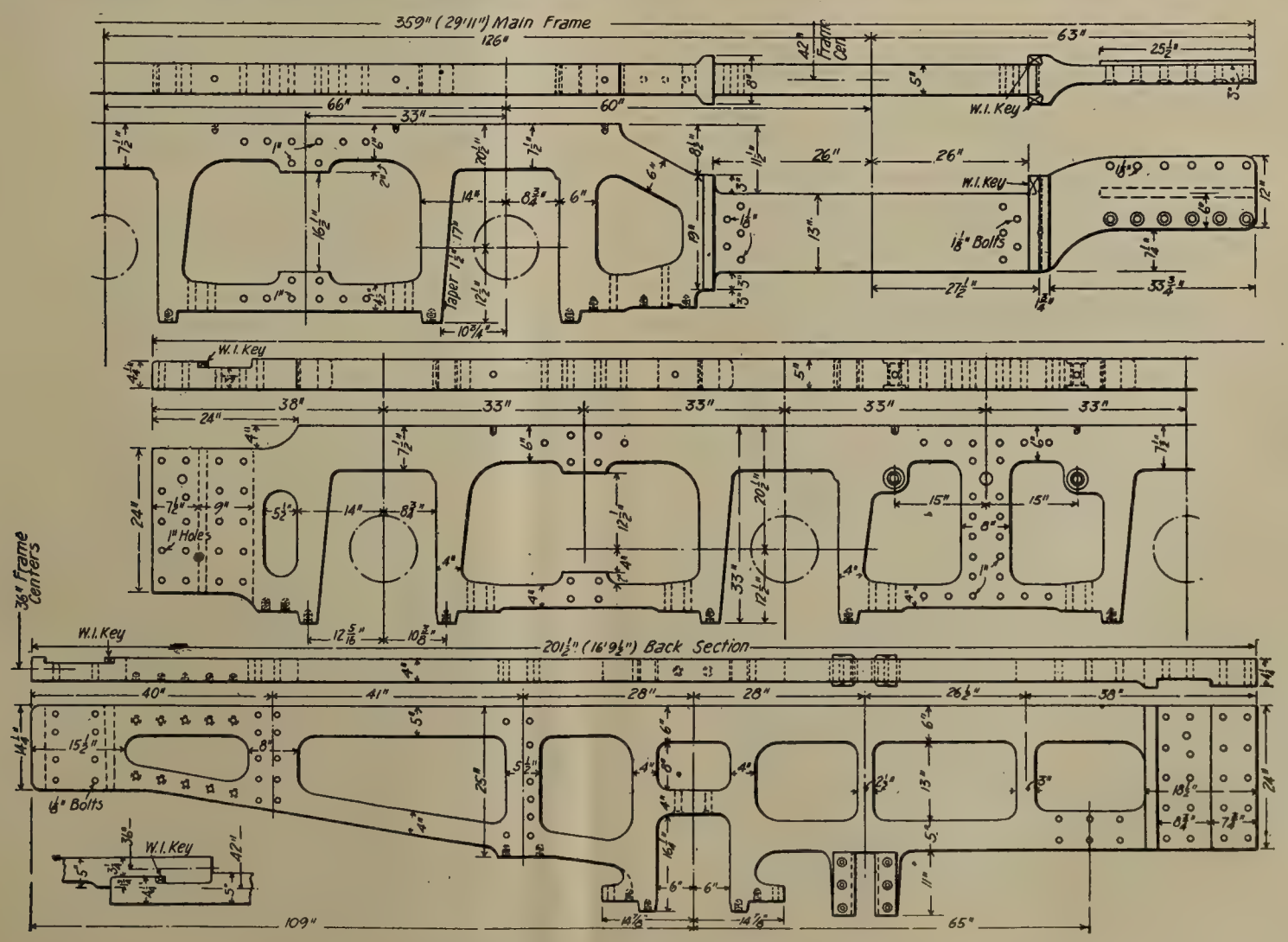
A screw reverse mechanism is provided for operating the link motion, which has proven entirely satisfactory. The Hodges trailer truck is used, to which are applied brake shoes equalizing with the driver brakes.

The grate surface is 9 x 12 or 108 square feet, which makes a very large firebox, to which is added a combustion chamber as generally used on this road in Wootten boilers. There is a brick wall built in the combustion chamber, and the grates are sloped gradually toward the front, making the large grate surface about as easy to fire as the ordinary wide firebox sizes in general use.

The proportion of the heating surface to grate surface was fixed at about thirty to one, which is considered good for burning the low grades of fine anthracite coal. This propor-



Interior Cab View, P. & R. Locomotive.



Details of Frame Construction, Philadelphia & Reading Locomotive.

tion required about 3,240 square feet of heating surface to take care of the 108 square feet of grate surface, to which was added 2,268 square feet of heating surface, making a total heating surface of 5,508 square feet. The extra 2,268 square feet was provided with the view of having this additional heating surface take the place of a superheater, which is not used on this engine. It is necessary to burn buckwheat coal at comparatively low furnace temperatures, which requires a large grate surface to get the best results. On this account the extra heating surface was added, in order to approximate the same fuel economy as might be obtained by the superheater, thus getting good efficiency from the coal without the extra complication incident to the use of the superheater. Thus far, in the operation of this locomotive, the smoke-box temperatures seem to be comparatively low, and the amounts of coal burned for the work done are relatively smaller than is required in other types of engines. No thorough tests have yet been made to determine the exact performance, but from its operation it seems to be well adapted to fast, heavy road service as well as slow heavy grade service.

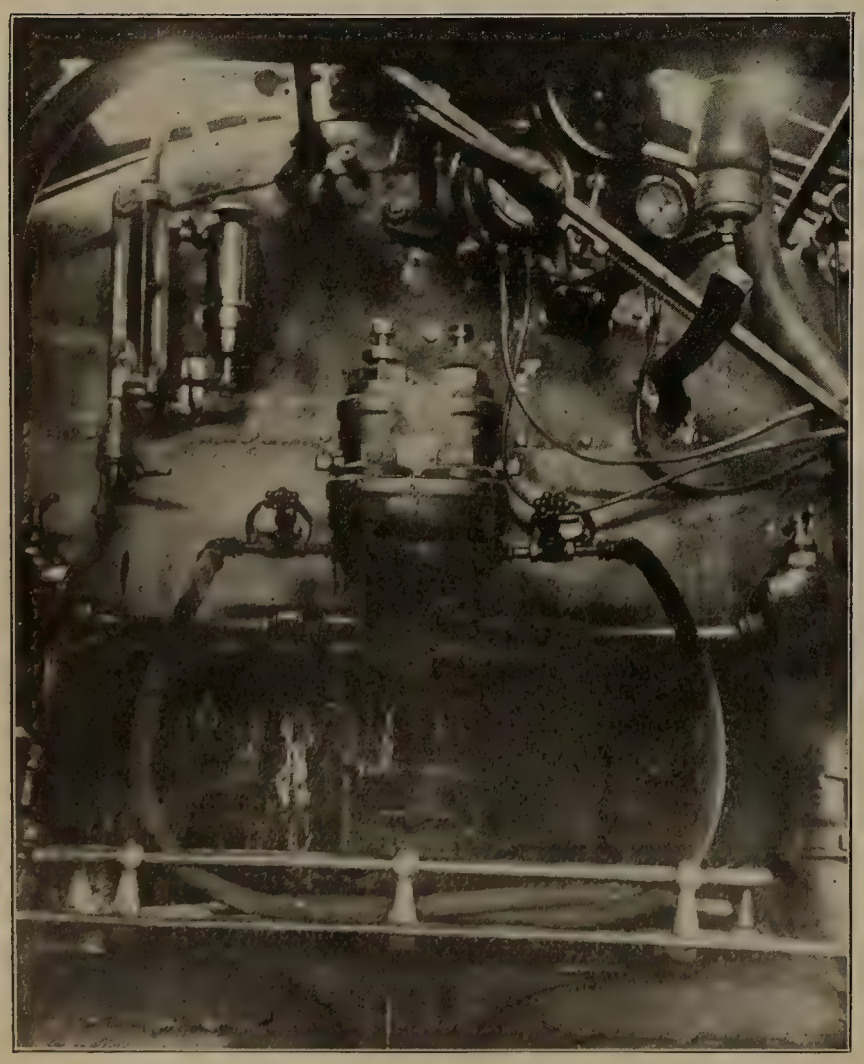
We are indebted for the information and illustrations given herewith to S. G. Thomson, superintendent of motive power of the Philadelphia & Reading.

General Data.

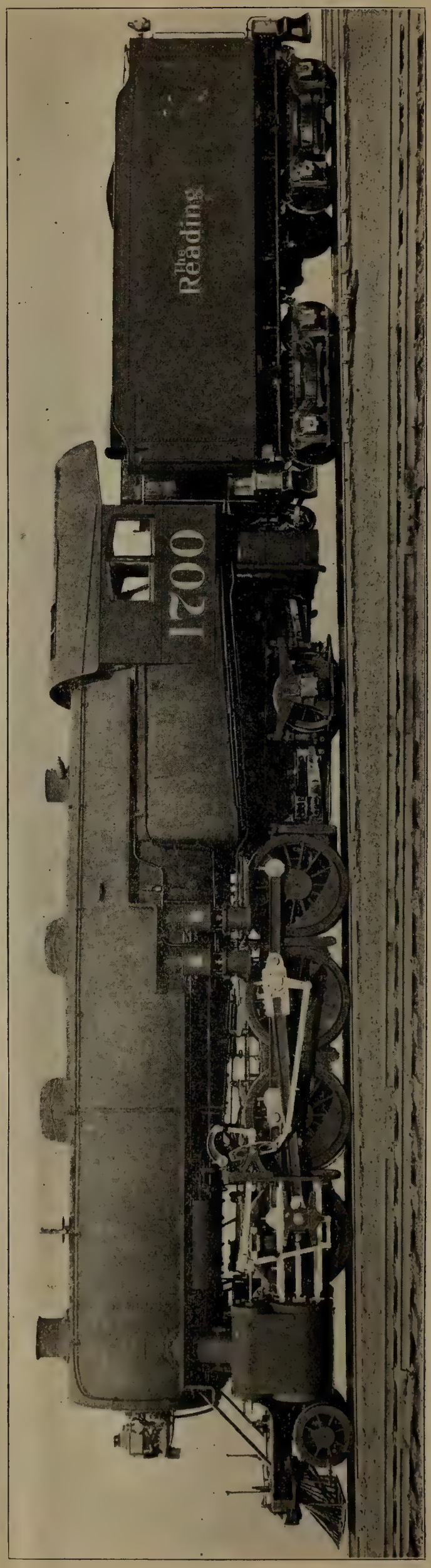
Tractive effort, 57,319 lbs.
Weight in working order, 331,000 lbs.
Weight on drivers, 249,000 lbs.
Weight on leading trucks, 25,100 lbs.
Weight on trailing trucks, 56,900 lbs.
Weight on engine and tender in working order, 491,000 lbs.
Wheel base, driving, 16 ft. 6 in.
Wheel base, engine and tender, 68 ft. 4¼ in.

Ratios.

Weight on drivers to tractive effort, 4.34.
Total weight to tractive effort, 5.77.
Tractive effort x diam. drivers to evap. heat surface, 640.



Interior Cab View, P. & R. Locomotive.



Large Mikado Built by the Philadelphia & Reading.

Evap. heat. surf. to grate area, 48.24.
Firebox heat. surf. to total heat. surf., 5.41%.
Weight on drivers to total evap. heat. surf., 45.2.
Total weight to total evap. heat. surf., 60.1.
Volume both cylinders, cu. ft., 16.75.
Total evap. heat. surf. to volume cylinders, 329.
Grate area to volume cylinders, 6.45.

Cylinders.

Kind, Simple.
Diameter and stroke, 24" x 32".

Valves.

Kind, Piston.
Diameter, 14".
Greatest travel, 6".
Outside lap, 1".
Inside clearance, $\frac{1}{16}$".
Lead, ¼".

Wheels.

Driving (diam. over tires), 61½".
Driving journals (diam. x length) main, 11" x 13".
Driving journals (diam. x length) others, 11" x 13".
Engine truck wheels (diam.), 33".
Engine truck journals, 7" x 11".
Trailing truck wheels (diam.), 42¾".
Trailing truck journals, 8" x 14".

Boiler.

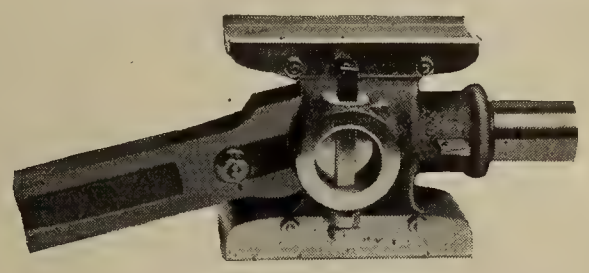
Working pressure, 225 lbs.
O. S. diam. first ring, 84".
O. S. diam. largest ring, 96".
Firebox length and width, 144" x 108".
Firebox plates, thickness, ⅜".
Firebox water space, 5" front, 4" sides, 4" back.
Tubes, number and outside diam., 504—2¼" o. s.
Tubes, length, 17'8".
Heating surface (tubes), 5210.
Heating surface, (firebox), 298.
Heating surface, total evaporating, 5508.
Grate area, 108 sq. ft.
Smoke stack height above rail, 15'.

Tender.

Frame, 12" channel.
Wheels (diam.), 36".
Journals (diam. and length), 5¾" x 10½".
Water capacity (gallons), 8,000.
Coal capacity (tons), 12.85 tons.

DOUGHERTY CROSSHEAD.

The crosshead shown in the illustrations has been patented by E. P. Dougherty, district foreman of the Southern Pacific at Imlay, Nev. The first of this type crosshead was applied on

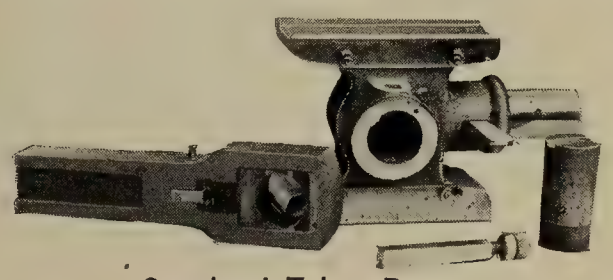


Crosshead in Place.

engine 1810 on the St. Louis, Iron Mountain & Southern at Van Buren, Ark., March, 1911, and is running with the same pin, having gone through the shop twice since that time. The second one was applied to the same engine on the opposite side in December, 1911. The last two have been applied on engine 1814 and have been in use about five months. These were put on at the shops of the Missouri Pacific at Sedalia, Mo., and the crossheads on engine 1810 have gone from one shopping to another without any repairs whatever.

Among the advantages claimed by Mr. Dougherty for his crosshead are:

1. Any wrist pin secured with nuts will work loose; but this

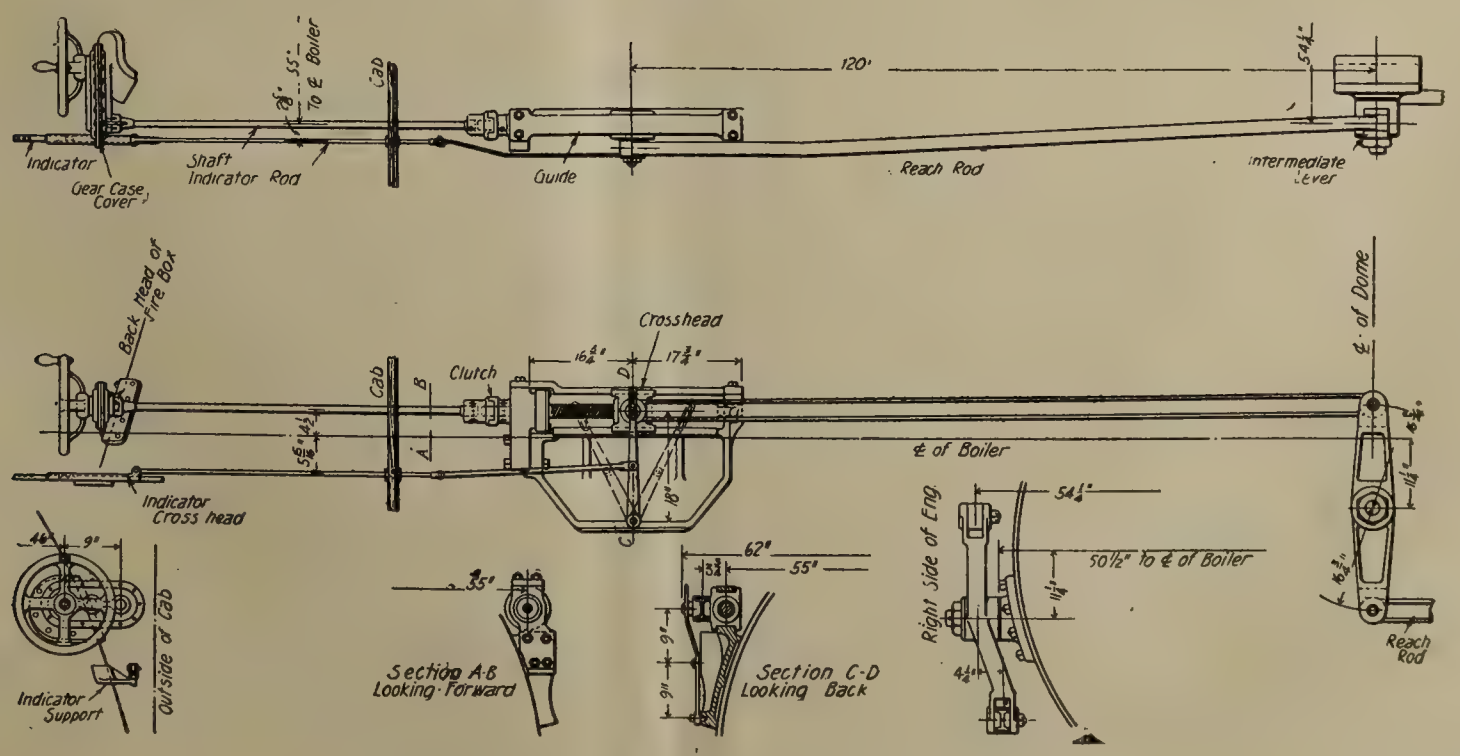


Crosshead Taken Down.

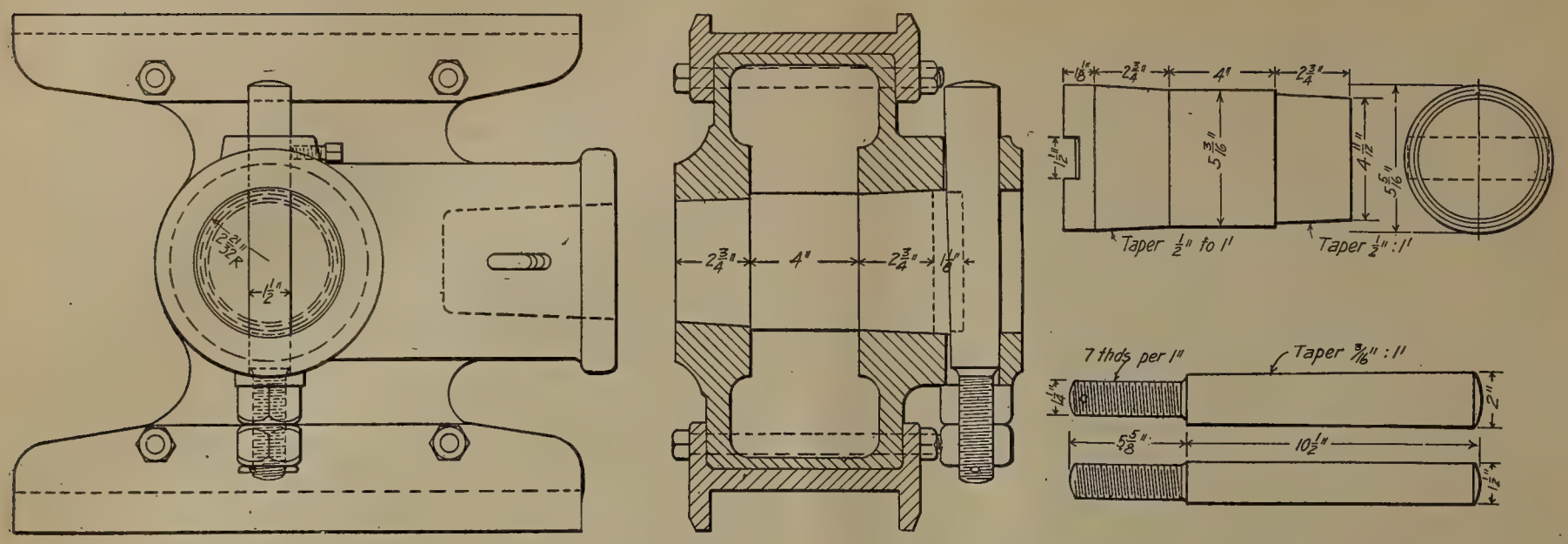
pin, secured with a key, will tighten up if there is any pound created in front end connections of the main rod.

2. When there is need to disconnect the front end it is not necessary to "spot" or place the engine in a certain position in order to take the pin out, as in the old style crossheads. One or both of these pins can be taken out in any position the engine is placed.

3. The brass bearings on the Dougherty pin may be left open ¼", as there is no danger of wrist pin turning in fit even if front connection is keyed too tight, for the key that keeps the pin tight against taper fit, also acts as a dowel to keep pin from turning,



Reversing Gear, Philadelphia & Reading Locomotive.



Details of Dougherty Crosshead.

as a pin of the old style usually does when keyed too tight. This ¼" wear will last several months, saving all the labor and expense of reducing front end brasses every three or four trips, as is necessary to do when they are fitted brass and brass as is the custom with the old style pins.

4. A great saving is made in making new pins, as material can be used near the size of the finished pin. There is no thread end to turn down, consequently, no threads to chase, no nuts or collar to make and besides the pin may be made in one-third the time it takes to make one of the old style. There is labor and material saved in every operation, and safety in every feature. And in casting the crosshead center, any style center can be used by adding the shell or boss to pattern, thereby saving the cost of making new patterns. The key-way is cast in the boss and cleaned up with a file.

The operation of disconnecting the pin is very simple. A collar is used that fits over the end of the boss, with holes in center through which a screw bolt enters and screws in tapped hole in end of the pin. This front end was disconnected and $\frac{1}{32}$" taken off of brass bearings and replaced in eleven minutes on a test.

The essential features are the simplicity of the wrist pin, the ease with which it can be connected or disconnected and the small cost of manufacture and operation.

NICKELIZED CAR WHEELS.

By Robert C. Totten.

In car wheel manufacture the use of nickel takes the place of the Bessemer non-chilling iron which is now used to overcome the hard, brittle chill made by remelting scrap car wheels. These must be remelted, as under the present system of exchanging a new wheel for an old one, it would be impossible to carry on a car wheel foundry without remelting a very considerable portion of scrap wheels. The present use of Bessemer pig iron modifies the character of the chill on the old scrap car wheel which may have been all right to begin with, changing it into a "mongrel chill" that does not have the same wearing qualities and consequently will not give as much mileage as a charcoal chilled wheel ought to give. Of course there is a remnant of charcoal iron in all old car wheels, or there would not be any chill, but using Bessemer or any brand of coke iron that has no chilling qualities whatever, tends to destroy the quality of the chill in the scrap chilled wheel whether it be much or little.

The use of nickel reduces the chilling qualities of the scrap car wheel mixture one-half. At the same time it changes one-half of the hard, brittle chill into a strong gray graphitic iron, which adds 100 per cent to the strength of the body of the wheel and toughens the chilled surface to such an extent that wheels made from it are said to have made 90,000 mileage under 50-ton capacity steel cars in mountain service with the appearance of being good for 100,000 mileage or over.

There is a mistaken idea that after all a nickelized wheel is only an "improved iron wheel" and not radically different like a steel wheel. It is claimed, however, that a nickelized chilled wheel has all the good qualities of the cold blast charcoal chilled wheel that was made fifty years ago, and in addition 100 per cent more strength. While it is properly called an improved chilled car wheel, it is radically different from the chilled wheel as it is being made today. By four years' use under 50-ton capacity steel cars it has performed the same service as steel wheels. The "skid spots" have only been 5 per cent, while a good railway authority connected with a first class system, says these "skid spots" equal 35 per cent with chilled wheels made of best quality of material but not nickelized. No flanges have broken, and wheels rejected for seams in the throat have been a very small proportion.

Under date of May 20th a Washington city correspondent refers as follows to the Interstate Commerce Commission's report of derailments during the months of July, August and September as follows, viz:

"The Interstate Commerce Commission have just issued a report of derailments in July, August and September, 1912. They give the total damage at $3,366,401, a large increase.

"It was found by the commission that of the derailments, 10 per cent were due to broken rails and 31 per cent to defective wheels."

This is $1,021,000 damage due to defective wheels in three months or $4,080,000 for the year, to say nothing of loss of life of employes. These facts emphasize the need of an improved chilled wheel as nine-tenths of all the wheels running are chilled wheels.

THE NUMBER OF PERSONS KILLED in train accidents during the months of October, November and December, 1912, as shown in reports made by steam railway companies to the Interstate Commerce Commission was 250, and the number of persons injured 4,334. The total number of casualties of all classes reported amounted to 2,967 persons killed and 51,323 persons injured. This statement includes 2,611 persons killed and 18,729 persons injured as the result of accidents sustained by employees while at work, by passengers getting on or off cars, by persons at highway crossings, by persons doing business at stations, etc., as well as by trespassers and others; and also 106 persons killed and 28,260 persons injured in casualties reported as "industrial accidents," which term covers accidents not involved in train operation, but occurring to railway employees, other than trainmen, on railway premises.

Standard Box Car Construction.

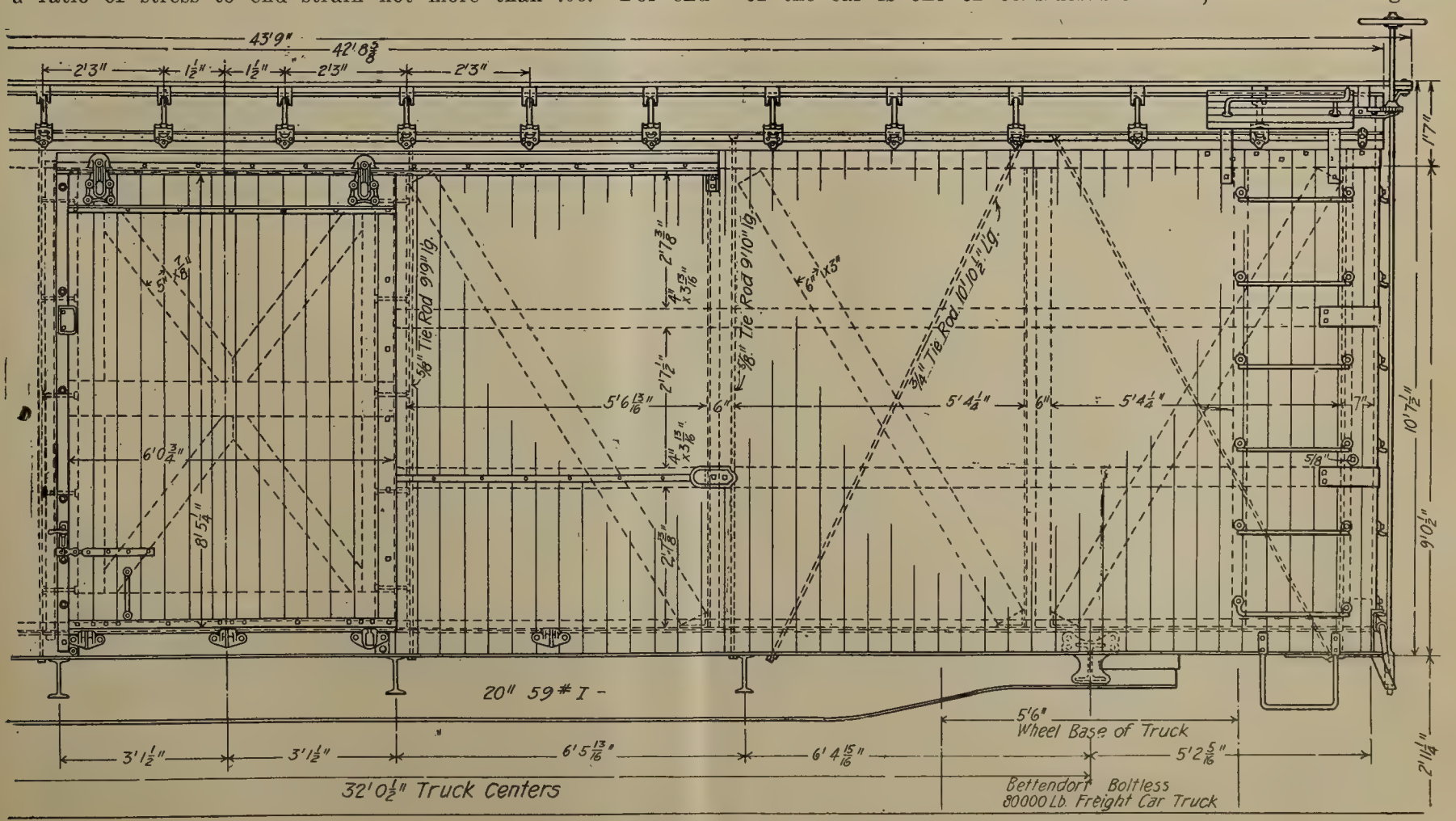
(Continued from June Issue)

In the preceding installment an outline was given of the work which has been done in the past in the direction of standardizing box car construction, together with descriptions of standard box cars in use on the Harriman Lines, Pennsylvania, Wabash and Canadian Pacific. Since that time the Master Car Builders' Committee on Car Construction has presented its report, as published on page 337 of the July issue. Briefly, it recommends that existing steel or steel underframe cars having center sill area of less than 16 sq. in. and ratio of stress to end strain more than .09 shall be classed with wooden cars. New cars must have a center sill area of not less than 24 sq. in. and a ratio of stress to end strain not more than .06. For end construction either all steel or steel reinforced ends should be used. Seals on end doors to be accessible from the ground or the end ladders. The steel reinforced ends recommended are similar to those used on Pennsylvania class X23 and X24 cars. This report is to be submitted to letter ballot for adoption as recommended practice. We give herewith the present standard box car construction of a number of roads.

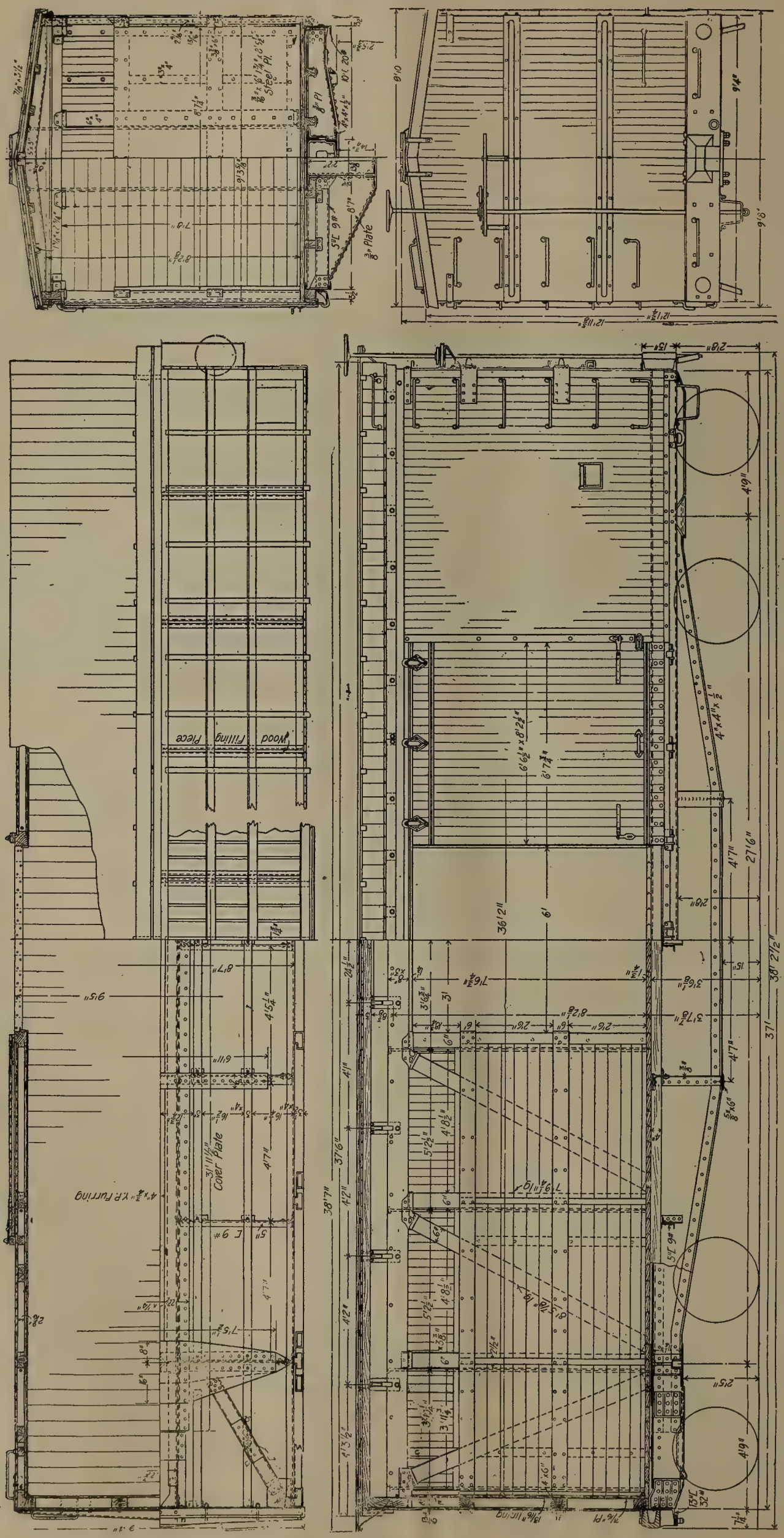
Philadelphia & Reading 85,000 Pounds Capacity Box Car.

Philadelphia & Reading.

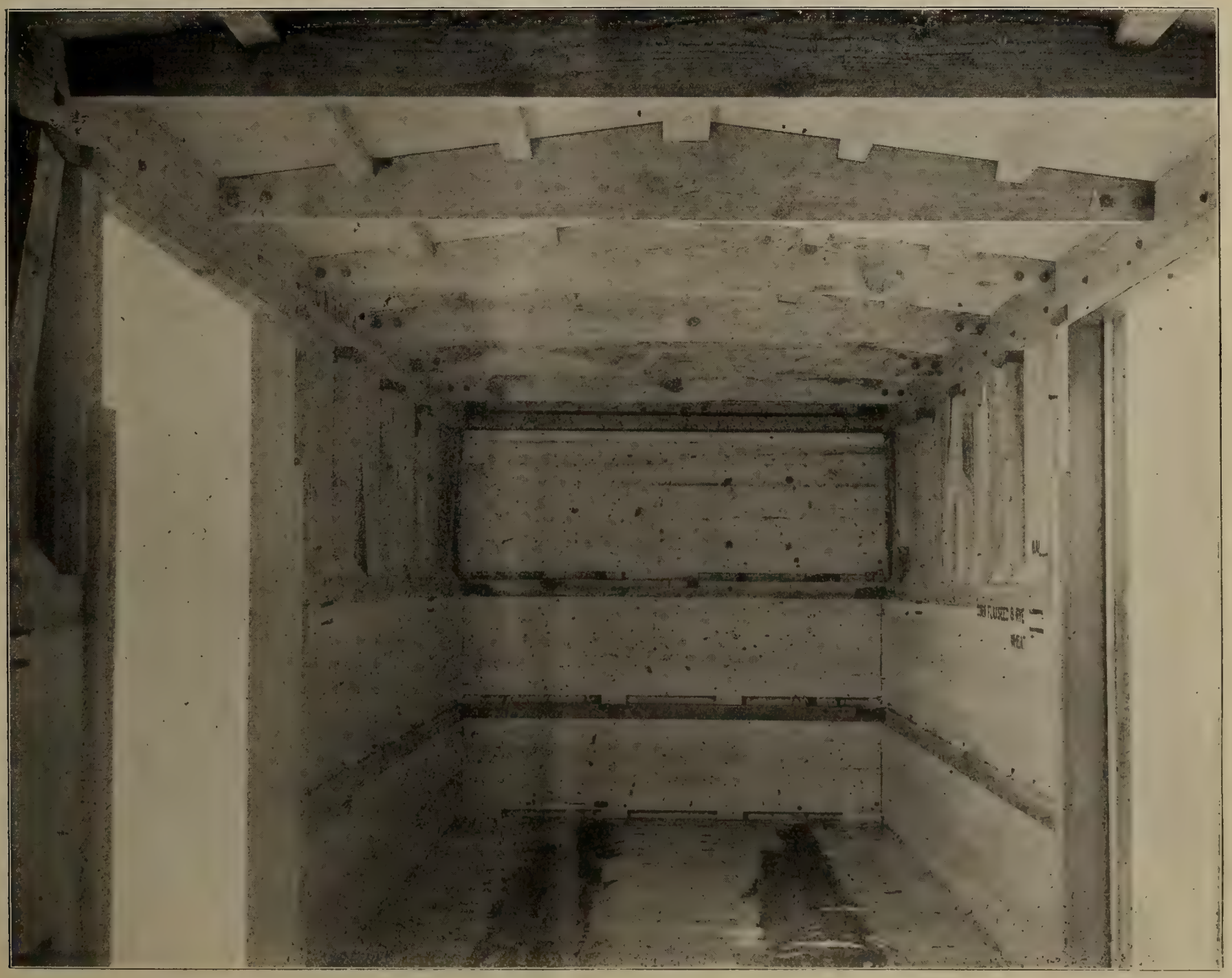
The present design of box car on this road has been in use some eight years and has given very satisfactory results. It is a 36-ft. car of 85,000 pounds capacity. The end framing of the car is one of considerable merit, as it lends a great



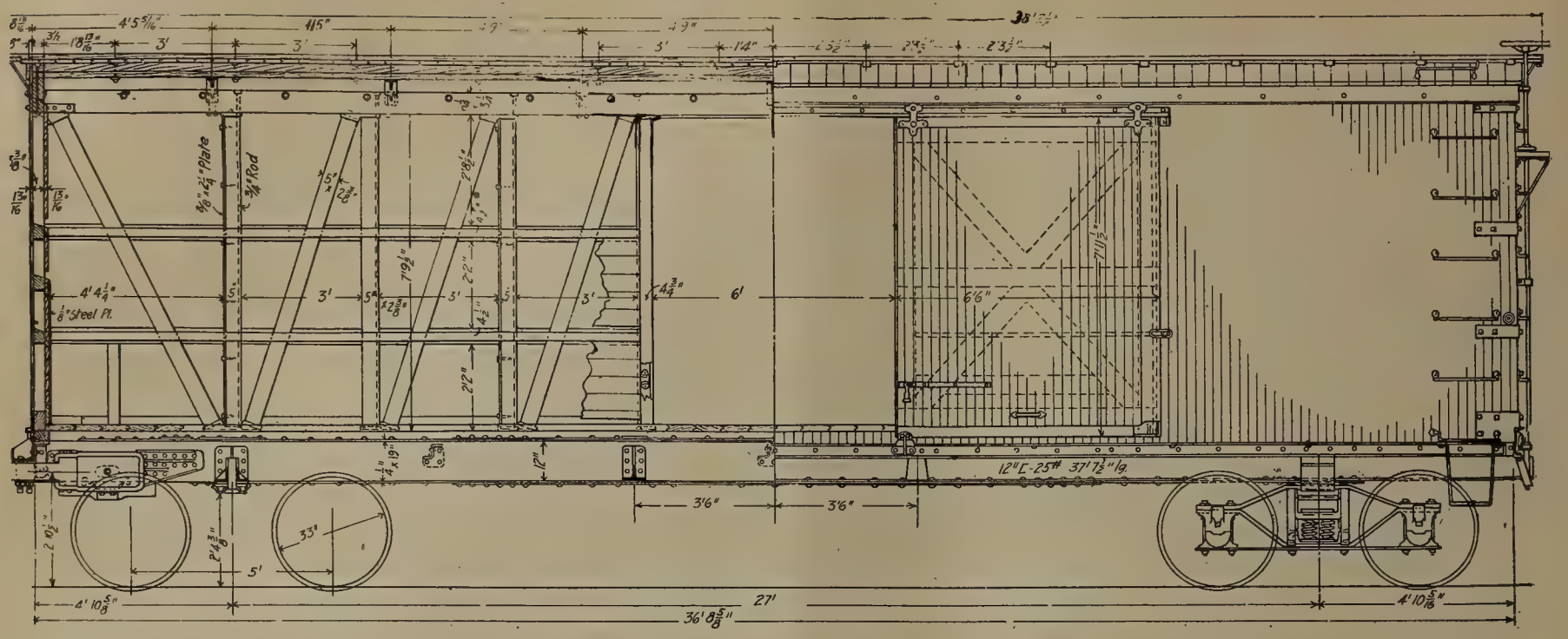
C., M. & St. P. 80,000 Pounds Capacity Box Car.


Steel Pl.
3/8" Plate
Wood Filling Piece
Cover Plate
4"x4"x 1/2" Y.R. Furring
4"x4 1/4"x 1/2"
Steel Underframe Box Car.
Philadelphia & Reading

Canadian Northern 60,000 Pounds Capacity Box Car.



Interior of Canadian Northern 60,000 Pounds Capacity Box Car.


38'7½"
4'5 5/16"
115"
3'
3'
3'

Delaware, Lackawanna & Western 60,000 Pounds Capacity Box Car.

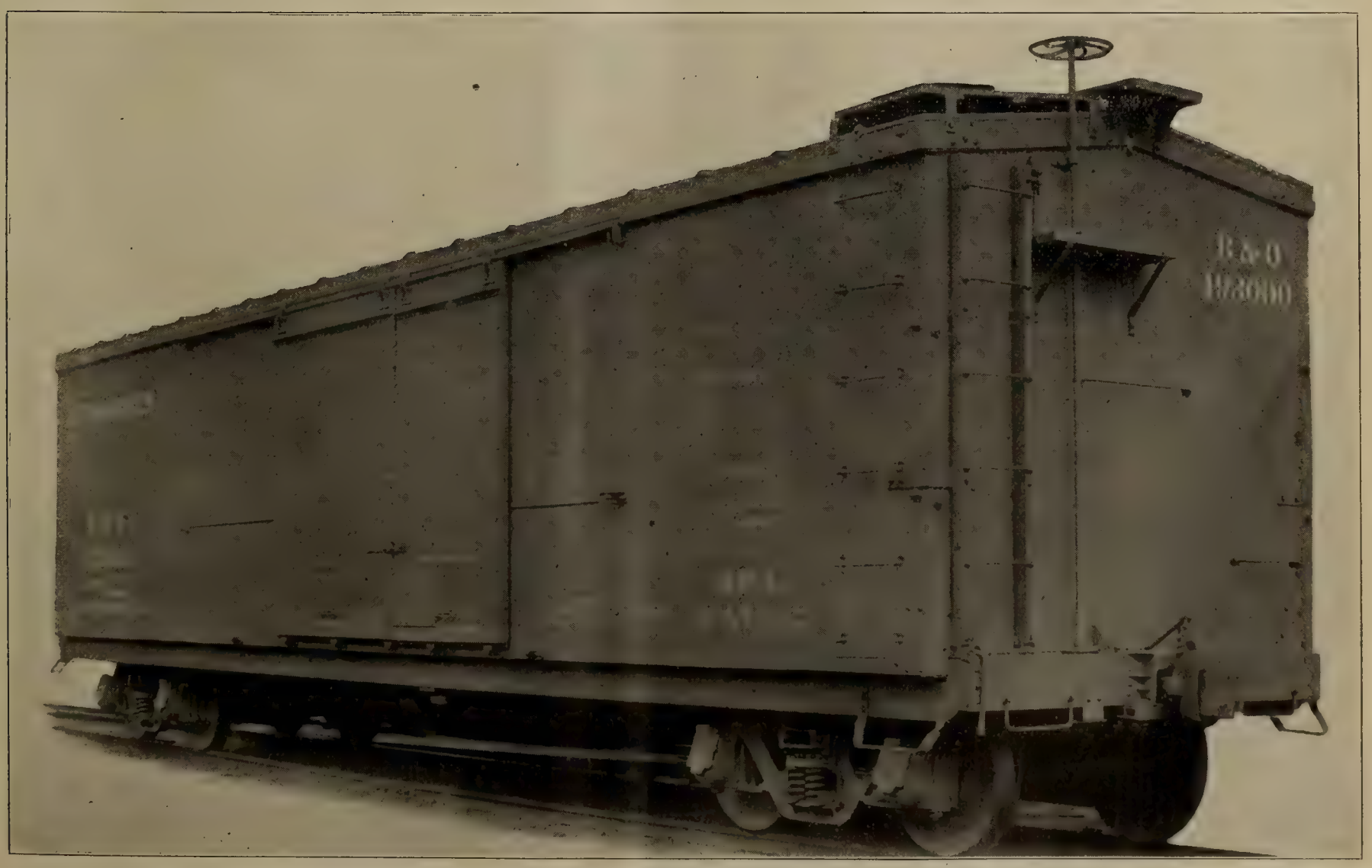
Chicago, Milwaukee & St. Paul.

This car, which is of 80,000-pound capacity, measures 42′-5⅛″ over end plates and 32′-0½″ between truck centers. It has a steel underframe with wooden superstructure, the timbers in the side bracing being 6″x3″ and those in the end 6″x4″. Details are shown in the illustration. The length inside is 41′-3⅛″; width inside, 8′-6½″, and height, 8′-0¼″.

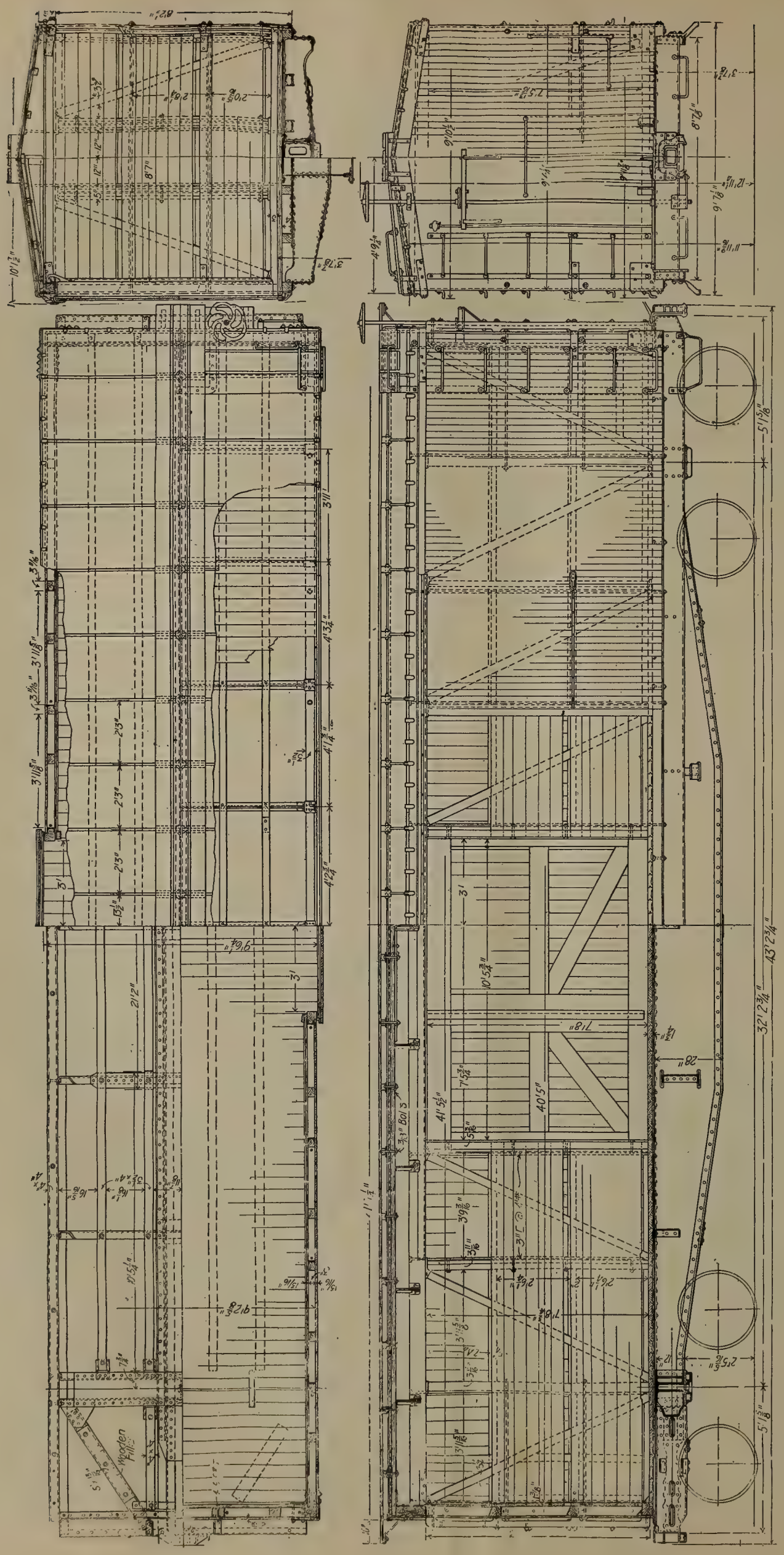
An automobile car is also built along similar lines, the side doors of which have a clear opening of ten feet. One end of this car is provided with swinging doors which open up the entire end. This car also has a double decking arrangement, the temporary floor being made adjustable in height by means of wooden blocks.

Baltimore & Ohio.

The standard box car of the Baltimore & Ohio, shown in the illustration, has a length inside of 40′-5″, inside width of 8′-7″ and height inside of 7′-5 3/16″. It is 80,000 pounds capacity and is the largest that can be operated over the B. & O. lines. The



Baltimore & Ohio 80,000 Pounds Capacity Box Car.



Baltimore & Ohio 80,000 Pounds Capacity Box Car.

end posts are reinforced with 4-in. 9.5-lb. I beams and the side posts are reinforced with 3-in. 4-lb. rolled channels, all posts having malleable iron shoes and caps on the ends. Double side doors are used, arranged for automobile shipments with movable door posts fastened to the small door. Security fixtures are used. An outside metal roof is applied, together with metal carlines. A layer of waterproof paper is placed between the running board saddles and roof sheets and caps. This is done to protect the roof sheets and prevent rusting under the saddles. It is standard practice on the B. & O. to apply roof boards transversely, as it has been found that when boards are applied longitudinally, the weaving of the car body will loosen the boards and push the nails up against the roof, eventually wearing holes in it. The brake step bracket has lips projecting over the outside edge of the step to prevent the board from splitting. The center casting is of cast steel, securely riveted to center sills and bolster diaphragms and is designed to withstand all forces concentrated at this point. Particular stress is put on the proper fitting of this casting to the underframe, it being required to fit solidly against all adjoining members. The trucks used on these cars are equipped with Barber rollers and cast steel truck bolsters are used, although some cars have been built with pressed steel truck bolsters.

Delaware, Lackawanna & Western.

The standard car on this road is a 36-ft. steel underframe car of 60,000 pounds capacity. All cars constructed during the past three years have been constructed according to the drawing shown in the illustration, with the exception of 100 cars, which have all-steel roof. It is one of these cars which is shown in the photographic reproduction. The cars have an inside width of 8′-6″ and an inside height of 8′-0″, with a 6-ft. door opening. The side braces are 5″x2⅜″ timbers. A plan has been under consideration for future cars to drop the center girder of the underframing 2″ in order to bring the center line of draft nearer to the neutral axis of the 12″ channel and do away with the reinforcing angles under the draft gear rod slots. It is also proposed to replace the cast steel needle beams with those of plate and angle construction. These changes will effect a reduction of 2″ in the height of the truck center plate.

Canadian Northern.

This is a 60,000 pounds capacity car of wooden construction having an inside length of 35′-10¾″, inside width of 8′-6⅛″ and inside height of 8′-0″. Wooden carlines are used and the side bracing timbers are 5″x2½″ and 4½″x2½″. It has no remarkable features, but is typical of the wood constructed car.

The table herewith gives some of the leading dimensions of the standard box cars of various roads.

Road.	Capacity in Lbs.	Length Inside.	Width Inside.	Height Inside.
Balt. & Ohio	80,000	40′- 5″	8′- 7″	7′- 5 13/16″
Buff., R. & P.	80,000	36′- 0″	8′- 6″	8′- 0″
Can. Nor.	60,000	35′-10¾″	8′- 6⅛″	8′- 0″
Can. Pac.	80,000	36′- 0″	8′- 6½″	8′- 0″
Cent. of Ga.	80,000	40′- 0″	8′- 6⅛″	7′- 8″
C., M. & St. P.	80,000	41′- 3⅛″	8′- 6½″	8′- 0¼″
Chi., R. I. & P.	80,000	40′- 0″	8′- 6″	8′- 0″
Del., L. & W.	60,000	36′- 0″	8′- 6″	8′- 0″
El., J. & E.	100,000	40′- 0″	8′- 6⅛″	8′- 0″
Erie	80,000	36′- 0″	8′- 6½″	8′- 0½″
Great Nor.	80,000	40′- 0″	8′- 7″	7′- 9¾″
Inter-Colonial	60,000	36′- 0″	8′- 6½″	7′- 8 7/16″
Louis. & N.	80,000	36′- 0″	8′- 6″	8′- 0″
M., K. & T.	80,000	36′- 0″	8′- 6″	8′- 0″
Nash., C. & St. L.	80,000	36′- 0″	8′- 6″	7′-10⅜″
Nor. Pac.	80,000	40′- 4½″	8′- 6″	8′- 8 9/16″
Penn.	100,000	40′- 5⅞″	8′-10″	9′- 1″
Phil. & Read.	80,000	36′- 2″	8′- 7¼″	8′- 2⅛″
St. L. & San F.	100,000	40′- 0″	8′- 6″	8′- 0″
Union Pac.	100,000	40′- 0⅝″	9′- 2″	9′- 2¼″
Wabash	80,000	36′- 5⅝″	8′- 6″	8′- 1″

Road.	Length Over Running Boards.	Distance Between Truck Centers.	Length Over End Sills.	Door Opening.
Balt. & Ohio	43′- 3¼″	32′- 2¾″	42′- 6″	10′-5¾″x7′-8″
Buff., R. & P.	38′- 1¾″	26′- 6″	38′- 2″	6′-0″ x7′-5¾″
Can. Nor.	38′- 4¾″	26′- 9¾″	36′- 9¾″	6′-0″ x7′-6″
Can. Pac.	38′- 5½″	26′-10″	36′- 4″	5′-0″ x7′-8″
Cent. of Ga.	42′- 4⅛″	30′- 9¼″	42′- 1¼″	6′-0″ x7′-6¾″
C., M. & St. P.	43′- 9″	32′- 0½″	42′- 5⅛″	6′-0¾″x8′-5¼″
Chi., R. I. & P.	40′- 3½″	31′- 0″	40′- 3½″	6′-0″ x7′-7¾″
Del., L. & W.	38′- 2¼″	27′- 0″	37′- 1⅝″	6′-0″ x7′-6½″
El., J. & E.	42′-10″	30′- 0″	41′- 9⅛″	5′-4½″x7′-7¾″
Erie	38′- 5½″	26′-10″	37′- 4¾″	6′-1½″x7′-7″
Great Nor.	42′- 0″	30′- 7⅝″	40′- 7⅝″	5′-5½″x7′-9¾″
Inter-Colonial	38′- 5½″	26′-10″	36′- 9⅝″	5′-0″ x7′-1″
Louis. & N.	38′- 4″	26′- 4½″	36′- 8½″	6′-0″ x7′-5¼″
M., K. & T.	38′- 6″	27′- 0½″	37′- 0½″	6′-0″ x7′-5½″
Nash., C.&St. L.	38′- 3″	26′- 8″	36′- 9½″	6′-0″ x7′-6¼″
Nor. Pac.	42′- 8″	31′- 4″	41′- 8½″	5′-6″ x8′-3⅛″
Penn.	42′-11½″	32′- 6″	42′- 6″	6′-0″ x7′-3⅝″
Phil. & Read.	38′- 7″	27′- 6″	38′- 2½″	6′-0″ x7′-6¾″
St. L. & San F.	42′- 1″	31′- 0″	40′-11″	6′-0″ x7′-7⅜″
Union Pac.	42′- 5″	30′- 8″	40′- 8⅜″	6′-0″ x8′-8⅞″
Wabash	38′- 7″	27′- 2″	37′- 4⅞″	6′-0″ x7′-7¾″

GREAT NORTHERN TANK CARS.

The Great Northern has recently received from the Milton plant of the American Car & Foundry Co. forty 12,000 gallon, 100,000 pounds capacity steel underframe tank cars. They are designated by the builders as Type Eight for underframes without tank head blocks, although they are modified to conform with some Great Northern requirements, including Farlow draft gear, Great Northern standard arch bar, brake beams and journal box lids.

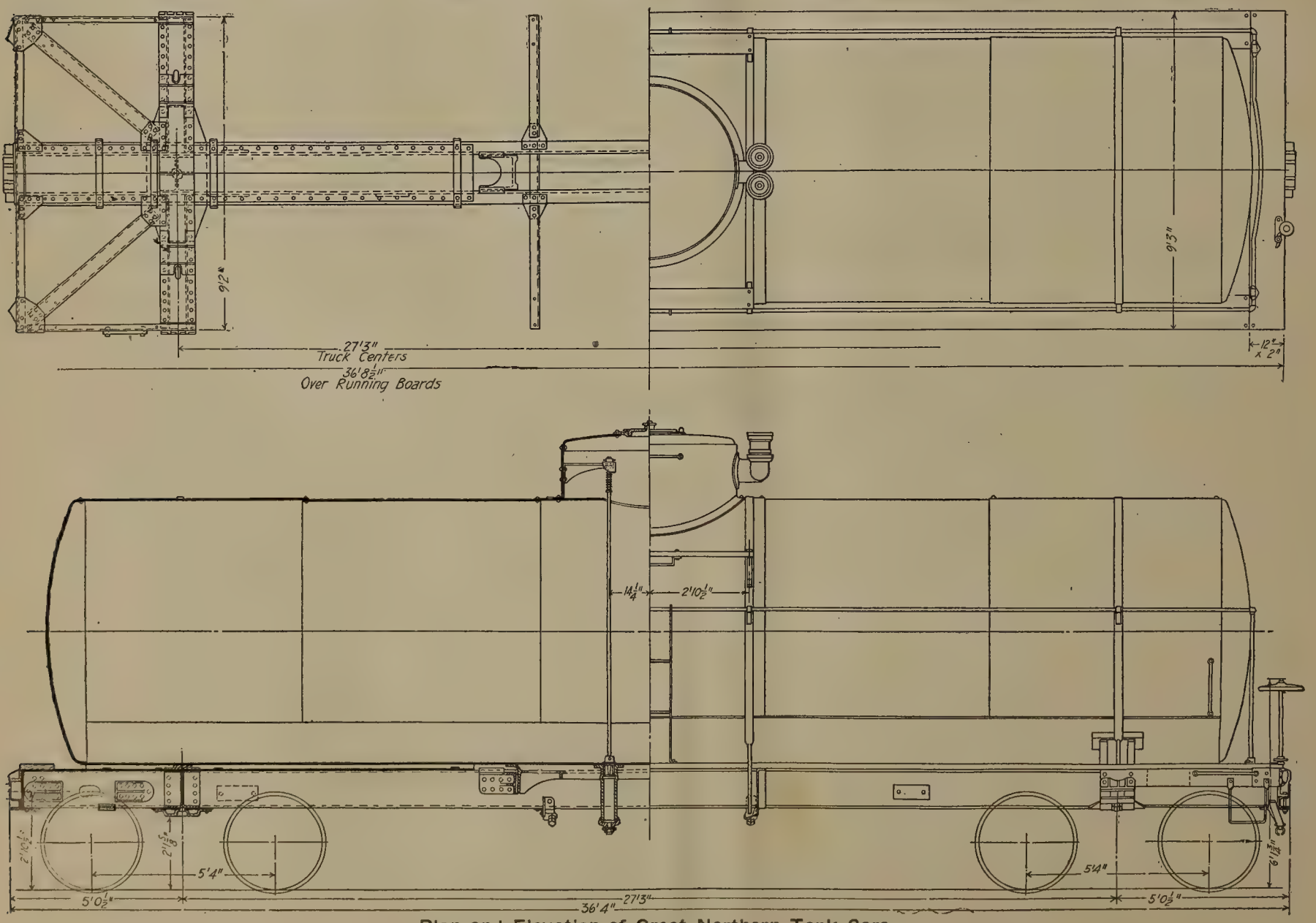
The center sills are 13-inch steel channels with a sectional area of 15 square inches, and extend the full length of the car in one piece, reinforced on top by two 20″ x 5/16″ cover plates, extending from end sill to anchor back stop castings near center of car, and on the bottom by two similar cover plates extending from the bolster toward the center of car. At the center the sills are tied together by means of two anchor block stop castings which, in connection with the anchor block casting riveted to the tank, prevent shifting of the tank. The side sills are 6″ steel channels weighing 8 pounds per foot. The end sills are 5/16″ pressed diaphragms connected to the side sills by malleable iron push pole pockets and to center sills by cast steel striking plates.

The body bolster consists of two ⅜″ web plates pressed into shape, reinforced on top by a 12″ x 12″ plate and having a 20½″ x ⅜″ bottom plate. The side bearings are forged and bolted to bolster so clearance may be adjusted. A forged strut extends up between the webs to reinforce them at this point. The runways and end platforms are of Southern pine. The tank anchor block is a casting securely riveted to the tank.

The tank has an inside diameter of 93½″ and a length (center to center of head rivets) of 33′. The shell of the tank is 5/16″ steel, the head 7/16″ steel dished to a 10′ radius, and the bottom sheet ⅜″ steel, 80″ wide. The dome is 5/16″ steel, 60″ in diameter and 18″ high. The outlet consists of a cast flange

New Great Northern Tank Car.

riveted to the bottom of the tank into which a section of 6″ pipe is tapped and provided at the bottom with a 4″ reducer and cover. The outlet valve is of the wing type operated by a 1⅛″ wrought iron rod, with a cam arrangement in the dome and held in closed position by a spring. Rivets are ⅝″ boiler rivets and are spaced 2″ on center in single rows for circular seams and dome and 1½″ staggered in double rows for longitudinal seams. The tanks are equipped with a 5″ twin type safety valve, one set to open at a pressure of 8 pounds per square inch and the other at 12 pounds. Twenty of these tanks are equipped with steam piping consisting of 8 lengths of standard 2″ steam pipe. The tanks were all tested to a pressure of 60 pounds per square inch. The accompanying illustrations show the features of the cars very clearly.



Plan and Elevation of Great Northern Tank Cars.

General Foremen's Convention.

The ninth annual convention of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, Ill., July 15, 16, 17, 18 and 19, 1913. The convention was called to order by F. C. Pickard, president of the association, and the meeting was opened with prayer by Bishop Fallows, of Chicago. A representative of Mayor Harrison welcomed the association to the city and he was responded to by W. T. Gale, of the Chicago and North Western.

In the annual address of President Pickard, which followed, he urged all members to study the various exhibits held in connection with the convention and to give all subjects a thorough discussion. Organization, he said, was a very important factor in assisting the general foreman to get the best results from his plant. He also urged the members to carefully consider and carry out the conclusions reached by the association and that the association therefore be very careful in reaching conclusions. Robert Quayle, superintendent of motive power of the Chicago & North Western, then appeared before the convention and, as usual, gave an inspiring address. The men, who in the past had done the small things the best they could, said Mr. Quayle, are the men holding the big positions today. He said that he had always been a firm believer in the value of railway associations and that each general foreman should be able to take home many valuable ideas. Hard work is the basis of all accomplishments and men should work for the love of doing things. Get good men for assistants and push them along; boost them. Cut out the lost motion in your work; in your shop. If you should ask me to name what is the greatest thing, I should say that it is character—the kind of a man you are. You must have a strong character, so that men will have confidence in you. When you give your word, men will depend on it.

The report of the secretary-treasurer showed that the association had 214 members and a balance on hand of $620. No further business was taken up on the opening day.

Superheater Locomotives.

The first subject taken up on Wednesday was "Superheater Locomotives," a paper on this subject being presented by P. C. Linck, of the Chicago & Eastern Illinois, extracts from which follow:

On one type superheater we have had trouble with steam pipe leaking, considerable of the trouble was due to the rings made of brass, they seemed to deteriorate very fast, we have changed these to a good grade of cast iron; we also found the joints were not made perfectly, the joints would be faced then ground in with air motor; they were probably ground too much, as they would appear to be a good fit, but on laying a straight edge across, they would be hollow inside, if ring was not put in exactly central it would be on a strain, and leak in a short time, by seeing that joints are perfect and by using cast iron rings we have overcome most of this trouble.

We have experienced some trouble with both types of superheater unit pipes, and return U's leaking where fitted together, generally at back end, but a few at front end, to make temporary repairs on the one type we plug the front end, but if left plugged too long, the back end will burn off, account of having no circulation through pipe, as soon as practicable we remove the pipes that are leaking, repair, and test before replacing. These can be removed without disturbing the steam pipes on the outside ones, the boiler front has to be removed. We made a special flue cutter for cutting off superheater unit pipes at steam pipe connection, and rolls for applying as a regular flue.

We had considerable trouble with the valve bushings, valve packing and cylinder packing on the first superheated engines. They were a Pacific type passenger engine equipped with Emerson superheater, 175 lbs. boiler pressure, 13" valve, 25½ x28" cylinders, placed in service October, 1910. Part of this trouble was on account of men not familiar with the best way of handling the manner of lubricating, and a great part the fault of metal used in these castings. The best quality of cast iron should be used for those parts; we have adopted the Hunt-Spiller gun metal iron for all cylinder packing, valve packing, and bushings, and steam pipe rings. We have very little trouble with valve packing since, we make the valve packing ⅛" large, cut out the proper amount, then have a jig for compressing together and turning off exact size of valve chamber. The later superheated engines were equipped with a semi-plug piston valve.

The piston heads seem to wear very fast, partly due to the weight of head, riding on cylinder. We have none equipped with the extension piston and it is a question, if it would be economical to apply extension piston and maintain it or to renew the heads every 8 or 9 months. We experimented by trying a composition of copper, lead, tin, zinc and antimony, applied to the bottom of piston head. We have it running on some of the engines for five or six months and it is giving good service. On one engine that had worn cylinder and piston head $\frac{5}{16}$" we applied this composition to piston head, three months afterward it showed $\frac{1}{16}$" wear of the metal applied.

The question of lubrication of superheater engines is one of the most important items. There is considerable discussion upon using a high grade of valve oil, that would withstand the heat before burning, or carbonizing. Quite a number use, and it has been recommended that a special grade of oil be used for superheated engines. This company has made no change, using the same grade of oil for all engines. We have made a few experiments and tested out different theories. One test was to attach a long copper pipe to lubricator on test rack, coil the pipe, and put in a forage at coils, heating to a red hot heat, letting the lubricator feed oil through the hot pipe, the oil came through heat in as good condition as it did when pipe was not hot, the oil being kept from burning by the steam as they both flowed through the pipe.

The first superheaters had a five feed lubricator, one feed to air pumps, one to each valve, and one to each cylinder. After the engines were running awhile, and we were having trouble with valve and cylinder packing, we connected a steam pipe from boiler into lubricator oil pipes that the engine while drifting would have a flow of saturated steam with the oil, to try to keep the oil from carbonizing, and to help lubricate the valves and cylinders with saturated steam. The engines received a year later were ordered with the booster valve applied to lubricator. On some of the engines we found the oil pipes from lubricator trapped or running up hill at boiler head slightly, instead of a direct and gradual fall from lubricator to valves. We tested this out on lubricator test rack, running a long oil pipe from lubricator to steam pipe, we connected a water glass into oil pipe at each end so we could watch the oil as it passed through with a gradual fall and without back pressure of steam, oil would flow through quickly, and evenly with it working against back pressure or into steam of the same pressure, it would take ten or fifteen minutes for oil to reach end of pipe, showing that lubricator should be started before throttle of engine is opened, to partly overcome this, oil plugs at steam chest are choked to 3/32 or ⅛", when oil pipe is trapped or are inclined up slightly, the oil would stop at this at this point until water has condensed in pipe, then the oil would all go at once, the valves, therefore, receiving the oil irregular while they should receive a small but constant supply of oil.

Another theory we have is to have the oil enter the steam as far away as possible that it may atomize and be thoroughly mixed with the steam, before reaching the parts to be lubricated. In our experiments, I believe it had proved correct; on this theory we removed the oil pipes leading to the cy-

W. W. Scott, Pres. General Foremen's Assn., and Son.

inders, and only used the feed to each valve. All the new engines purchased since, eight Pacific type passenger engines, 13″ valve, 26½x28″ cylinder, 185 lb. boiler pressure, 25 Mikado superheater freight engines, 13″ valve, 28x30″ cylinder were ordered with only a three feed lubricator, with booster valve attached, we have had but comparatively little trouble with these engines.

On October 1, 1912, we put in service a Baldwin balanced compound engine that we had just given general repairs, and applied a superheater, the high pressure cylinders are 16x26″, low pressure 26x26″, and the piston valve 15″ diameter. This valve is one casting, but acts as a double valve, admitting steam to high pressure cylinder and exhaust back through it to low pressure cylinders, one valve and packing rings weigh 412 pounds, there are 12 rings on each valve. There was a question as to how to lubricate this engine; it was recommended to use a seven feed lubricator, a feed for each valve, each cylinder and air pumps. We started the engine out on the theory to have the oil enter steam as far back as possible from parts to be lubricated, that the oil may be thoroughly atomized and mixed with steam before reaching valve, we only used one feed from lubricator to each side of engine. We drilled holes high as possible in cylinder saddle wall to steam cavity, and made long oil plug to reach to center of steam cavity.

After engine had made several trips we examined and measured the size of each cylinder and valve, the engine was well lubricated, but the least lubrication was at first admission to valve, after it had passed through high pressure cylinder, back through valve, into low pressure cylinder, there was more oil, and better lubrication, the center of lower pressure cylinder seemed to be the best lubricated. We changed the oil pipe plugs to get oil further back from valves. We drilled hole through smoke arch into steam pipe in front end, and put oil plug into center of steam pipe in the center of smoke arch. The engine has been in heavy fast passenger service and is doing excellent work with very little trouble. In December we applied National Graphite Lubricator to this engine, the valves, etc., being very heavy, it is expected to reduce friction, wear, and handle easier, therefore use less fuel.

We had superheaters applied to several Pittsburg cross-over compound engines, they have piston valve on high pressure and slide valve on low pressure cylinders. They have a four feed lubricator without the booster valve, we attached a steam pipe direct from boiler to lubricator oil pipes. We removed the oil pipe form intercepting valve and put it on high pressure side through smoke arch into steam pipe, expecting the oil when engine is working simple to go with steam direct to intercepting valve, when working compound to go through high pressure valve, cylinder and receiving pipe, to the intercepting and separate exhaust valves. The high pressure steam with oil admitted to it, would be in contact with part of the intercepting valve. On trial one part of the intercepting valve did not appear to receive enough oil. We put a tee in the low pressure oil pipe and run it to intercepting valve, it receiving part of the oil from the low pressure valve oil pipe, the low pressure receiving part of the oil with the exhaust from high pressure side.

We had trouble with piston packing melting on high pressure side of these engines. The composition of the piston packing was changed, and by-pass valves applied to the high pressure side of the engine, expecting to relieve any excessive compression. These engines originally had these valves but were not used for several years, they are giving comparatively little trouble now.

On receiving general repairs, flues or steam pipe work on one type, we remove the steam pipes and superheater unit pipes together, we have a boiler plate bracket to fasten and hold the pipes in proper position, handling them with the electric crane, they are repaired and joints made on steam pipes and given a hydrostatic test of 250 lbs. They are then handled with crane and replaced in engine. After all joints are tightened we apply a water test to see that all joints and connections are tight. The other type we handle one unit at a

Wm. Hall, Sec. General Foremen's Assn., and W. W. Hoffman, Foreman Shops, C. & N. W. Ry., Milwaukee, Wis.

Main Exhibit Room, General Foremen's Convention, Looking North.

time, each unit is tested separately; we have a tool which we mentioned before that we connect to unit pipes and apply a water and air pressure of 200 lbs. Where one or two unit pipes are broken below the ball joint, it is the practice at some places to splice the pipe with a steel coupling, making the ball on short piece of the unit pipe in the smith shop, on a die similar to a bolt header die, afterwards finished to proper size. We have applied the ball end to new unit pipes in this way, finishing on turret lathe to a standard farmer for ball joint. We have just finished welding with acetyline a set of return bends on the fire box end, at the time of this writing. The weld stood the 250 lb. hydro. test, and made several trips on the road, with no defects developed yet.

We have made quite a number of small special tools, the formers for grinding superheater header, and unit pipe ball joints, we found gave the best service made of copper. We have reamers for these, so when they are worn or not standard, all that is necessary is to use a reamer to keep the formers standard. We made cutter for cutting large holes in flue sheet, a ball reamer for removing sharp edge after cutting the holes, a roller for copper ferrules in back flue sheet, rolls for applying unit pipes on the Emerson, rolls and prosser expanders for working the large flues, machine for cutting all size flues, gig to hold steam pipe rings, to be ground with air motor, one for drilling and reaming holes on superheater header, standard gauges to keep all beading tools, prosser expanders and ball joints to a standard. These should be carefully checked as an odd size beading tool or prosser may do considerable damage to the flue or flue sheet.

In renewing the flues at first we had to take the large superheater flues to the pipe shop, have ends cut off in pipe machine, back to boiler shop and weld on safe ends, back to pipe shop to cut right length. To avoid transferring, and to expedite the work, we had the flue cutting machine remodeled, the old machine worked with hand screw feed for cutting flues, we had new machine made with air cylinder to feed cutter through flue, also a clamp or steady rest to hold other end of flue while cutting, this operates with air, they are both operated by one foot pedal located about the center of machine, so the operator does not have to move from center of machine in handling the flues. The welding machine was changed slightly, and new mandril made for welding the large flues. The flue plant is arranged so flues pass through with one handling, they are rolled out of cleaner on short inclined rails to flue cutting machine, passed on to furnace, then to flue welding, safe ends welded on, passed on to next flue cutting machine, and cut to rail length, passed to hydro pneumatic testing machine, tested at 250 lbs. pressure, then to grinder to have scale and burr removed, then loaded on car or wagon for delivery to engine or shipment.

In removing flues from boiler, the front end should be cut off as close inside the sheet as possible, the back end should be cut far enough to free it from prosser marks, or if safe ends have been applied they should be cut off to remove the old weld, maintaining only one weld on the swaged ends of the flues. In cleaning the flues, care should be taken that there are no rivet heads or projections inside the rattler, the large flues are considerably heavier than the 2" or 2¼" flue, therefore must be handled more carefully, and any projections will dent the flues or cause the ends to start to crack, making it necessary to cut considerably off the flue in order to square up the end, or if dented and the dents not removed, it will make it difficult to insert the units in the flues.

The safe ending of the large flues is to be done at the fire box end, rather than smoke box end, this provides new material where service conditions are most severe. It is recommended that the safe end be annealed after applied, in order to prevent liability of cracking and permit it being worked more easily in the flue sheet. When safe ends have been applied so that all space has been utilized, between flue sheet and return bends, the flue should be reswaged, and a long safe end or extension applied to the front end of the flue, being careful to leave it smooth with no obstruction, on the inside of flue, that would prevent or make difficult to insert the units into the flue.

In welding 4½" tubing it is a good practice to scraf the safe end for a distance of about ⅝" and heat the end of the flue, bell-mouth it and insert the safe end while the flue is hot.

This practice insures the piece sticking in the flues in proper place until it is heated and in position in the welding machine. It may be found in attempting to weld the large flues, that trouble will be experienced in bringing the material down at the point of the weld uniformly to the thickness of the flue. The scarfing of the flue tends to lessen the difficulty experienced in bringing the metal down. It is important that the welded portion of the flue be smooth on the inside, thereby removing all obstructions and facilitating the cleaning of the flues.

On account of the weight of the flues, there may be some difficulty experienced in handling them. A heavy flue rest should be provided at the back of the welding machine and furnace, equipped with a spool or thimble, the same to be subjected to adjustment so that the flue may be uniformly supported and kept in line with the mandril and the furnace and the welding machine during the time that the heat is being made and the welding operation carried on. The difficulty in safe ending large flues may be thus readily overcome by the proper methods of handling, heating and a machine designed to do the work satisfactorily.

Among the general difficulties experienced in tube welding, in the past, has been the use of the improper dies, particularly if used on hammer welding machine; on roller machines, rollers not properly adjusted, thus preventing the necessary pressure on the material, which must be obtained to secure a good smooth weld. Another trouble has been furnaces that do not heat fast enough, the result being an excess amount of oxidation or loss of material; furnaces where the heat is too harsh and the action of the air blast too severe on the material, resulting in a loss of material before the flue is ready to be taken from the furnace Good flue welding demands that the flues and safe ends be heated in a furnace that gives a soft non-oxidizing heat that will heat the material uniformly to a good welding heat as quickly as possible.

In placing the header in the front end, it should be so set that the face will parallel to the center lines of the top row of flues, and each end of the face the same distance above center line of outside flues of the top row. The header supports should be securely bolted to smoke arch to hold header in proper place and made so that the header will bear upon them throughout its entire width.

Care should be taken that the flue sheet is laid off the proper distance from the center of dry pipe flue sheet hole, and equal distances across, that it corresponds with header, and that units rest near the top of flue when they are tightened in place, that they may have free circulation, and flue cleaning pipe will go under the units. If the joints on pipe do not pull up true to correspond with holes in header, they should be bent or sprung in place and not allowed to drag in place by turning up on the nuts. When the units are in place and tightened, they should be in the upper part of the flue.

When everything is tightened in place, apply a water test with 250 lbs. pressure. After boiler has been steamed up and superheater tested with steam, the bolts should be gone over and tightened finally. Suitable wrenches should be provided that will reach all unit bolts. These wrenches consist of a single socket wrench made to fit nuts and clean unit pipes. With an extension long enough to allow a bar to be used in turning it without interferring with the units and short enough that it may be used without removing the table plate or damper. A peep hole should be provided in the side of the smoke arch to permit the inspection of the front end flue sheet, superheater units and ball joint connections without removing the baffle plates.

All superheater flues should be beaded in front flue sheet. The baffle plates should be made to fit tight and should be so constructed that they can be removed without removing the door ring. The damper when connected to steam chests, should be put up so that when weight is down the damper will be closed, when the weight is raised the damper should be open. When connected to the blower, its operating is reversed. Care should be taken that it operates freely.

On the road it is recommended to carry a level fire, as thin as conditions will permit, and endeavor to maintain a bright white fire over the entire grate. Do not carry more than two gauges of water, dry steam should show at the third gauge, working on level track. Exceptions are permissible where the engine foams, this should be reported at terminal. The throttle should be slightly cracked when drifting, so that the steam can carry the oil to the valves and cylinders as well as prevent air from entering cylinders.

The lubricator should be started ten minutes before leaving time at terminal, and should be fed regularly and constantly while running. About 25% more oil should be used with a superheater engine, than a saturated engine of the same size and in the same service. In running a full throttle is recommended wherever it is possible. The reverse lever should be cut back to permit the use of the full throttle until the most economical point of cut off is reached, which is about 25%. If further reduction of power is required, it should be obtained by throttling the reverse lever remaining at 25% cut off.

In the discussion which followed, W. W. Scott, of the D., L. & W., said that there were 28 superheaters in service on that road and that they had had good success in putting in header bolts hot. This had proved very successful. Mr. Smith, of the Delaware & Hudson, stated that the most important thing in a superheated engine is to keep down the friction and that it is not good practice to spring rings in. Oil pipes should have a gradual drop from the lubricator to the chest and the steam should be lubricated before it gets to the cylinder, as the present tendency is to do away with cylinder feeds. Oil pipes have a tendency to harden and if they are annealed every time the engine is repaired it will do away with much of this trouble. In changing engines over to superheaters, the large injector is often left on and the boiler is flooded. Oxyacetylene has been used very successfully for cutting out front end tubes on the New York Central Lines. C. D. Ashmore, of the Chicago & North Western, said that 25% more oil should be used on superheaters and that they had had no trouble with the packed ends of tubes breaking. We used an alloy of copper and lead for piston packing. Mr. Scott stated that it was his experience that the carbonizing of valve oil destroyed the piston valve ring and that graphite was used very successfully as a lubricant. F. C. Pickard, of the D., L. & W., said that they had gone into the problem of lubrication on superheaters very thoroughly and that with the graphite lubricator the problem was to get the graphite to the cylinders as used. On our superheater Mikados we opened up the nozzle to 6¼ inches. In applying the bolts we heated them to a black heat—that is, the heat that the bolts were subjected to under working conditions—and found it to be very successful, there being no steam failures or leakages. Mr. Ostermann, of the Locomotive Superheater Co., answered a number of questions put to him with regard to various details.

Election of Officers.

At the close of the discussion on Wednesday the election of officers was held and resulted as follows: President, W. W. Scott, Delaware, Lackawanna & Western, Buffalo, N. Y.; first vice-president, T. F. Griffin, C., C., C. & St. L. Ry., Indianapolis, Ind.; second vice-president, L. A. North, Ill. Cent. R. R., Chicago; third vice-president, Wm. Smith, New York Central Lines, New York; fourth vice-president, W. T. Gale, C. & N. W. Ry., Chicago; secretary-treasurer, Wm. Hall., C. & N. W. Ry., Winona, Minn. C. N. Newman, of the Atlantic Coast Line, was elected a member of the executive committee to succeed W. T. Gale, who had been elected a vice-president. G. H. Logan was re-elected a member of the executive committee.

Apprenticeship Systems.

The first report taken up on Thursday was that of the committee on apprenticeship which consisted of F. W. Thomas

A Bunch of Genial North-Western Men Who Helped to Make the Visit of the General Foremen to the Chicago Shops Both Interesting and Profitable. Left to Right: T. E. Williams, Master Blacksmith; J. Murrin, Superintendent of Shops; H. T. Bentley, Assistant Superintendent of Motive Power, and C. D. Ashmore, General Foreman at Clinton, Iowa.

(chairman), C. W. Cross and E. V. Lea. It was illustrated with lantern slides. The committee sent a list of seventeen questions on the subject to forty-five concerns, twenty-five of which were railway companies and the remainder industrial concerns. The replies showed that 4,925 apprentices were employed by the railways and 3,004 by other corporations, ranging between the ages of 15 and 22. These embraced 168 railway shops and 38 industrial plants. The large majority of the roads had 4 years as the length of apprenticeship and on an average 3.61 hours were spent by the apprentices in school per week. Seventy-seven per cent of the railway graduates remained in service, while 56% of the industrial graduates remained. Quoting from the report:

From the information received it is evident that the subject of apprenticeship is attracting considerable attention, and there has been a substantial development in the work. In addition to the larger and more prosperous railroads in the country, nearly all of the large industrial concerns have instituted educational courses; some of these have regular apprentice schools, others co-operate with the public schools in the continuation schools or part-time system and still others have made arangements whereby the men whom they are training may receive instruction through the correspondence schools or Y. M. C. A. schools. These courses are offered to their employes not only by the large corporations making railway supplies but by the large department stores, etc.; even large banking concerns organizing schools to train men to handle their auxiliary organizations such as gas and electric power companies, street railways, etc. Many of the men trained by the large supply companies go out and work for the companies purchasing their supplies. In addition to teaching these men subjects relating directly to the needs of their respective organizations, they also teach character building, politeness, and the ability to "get along." Probably some 200 corporations are now offering their employes educational advantages, paying them for the time spent in school. They would not be doing this if it did not pay them in dollars and cents.

The committee unhesitatingly recommend to the association that the question of apprenticeship is worthy of consideration by the officers of railroads and manufacturing concerns, and submit the following reasons:

First: Apprentices have proven satisfactory from a commercial standpoint.

Second: Graduate apprentices have been advanced to positions of authority in many shops. The apprenticeship system is harmonious in a shop employing either the day work or piece work system. Your committee, recognizing the fact that there is a wide difference in organization and local conditions as to available material and facilities for instruction, considers that a hard-and-fast general apprenticeship code is impracticable and therefore suggests the substitution of basic principles rather than a formal code.

To assure the success of the apprenticeship system, the following principles seem to be vital, whether the organization is large or small:

First: To develop from the ranks in the shortest possible time, carefully selected young men for the purpose of supplying leading workmen for future needs, with the expectation that those capable of advancement will reveal their ability and take the places in the organization for which they are qualified.

Second: A competent person must be given the responsibility of the apprenticeship scheme. He must be given adequate authority, and he must have sufficient attention from the head of the department. He should conduct through shop training of the apprentices, and, in close connection therewith, should develop a scheme of mental training, having necessary assistance in both. The mental training should be compulsory and conducted during working hours, at the expense of the company.

Third: Apprentices should be accepted after careful examination by the apprentice instructor.

Fourth: There should be a probationary period before apprentices are finally accepted; this period to apply to the apprentice term if the candidate is accepted. The scheme should provide for those candidates for apprenticeship who may be better prepared as to education and experience than is expected of the usual candidate.

Fifth: Suitable records should be kept of the work and standing of apprentices.

Sixth: Certificates or diplomas should be awarded to those successfully completing the apprenticeship course. The entire scheme should be planned and administered to give these diplomas the highest possible value.

Seventh: Rewards in the form of additional education, both manual and mental, should be given apprentices of the highest standing.

Eighth: It is of the greatest importance that those in charge of apprentices should be most carefully selected. They have the responsibility of preparing the men on whom the roads are to rely in the future. They must be men possessing the necessary ability, coupled with appreciation of their responsibilities.

Ninth: Interest in the scheme must begin at the top, and it must be enthusiastically supported by the management.

Tenth: Apprenticeship should be considered as a recruiting system and greatest care should be taken to retain graduated apprentices in the service of the company.

Eleventh: Organization should be such as graduated apprentices can afford to enter for their life work.

In addition to the principles set forth above, your committee urges the necessity of having adequate instructions for the shop and not submerging this part of the boy's education with the school room work. While we recognize the great value of the school room instruction, we believe the one should supplement the other. The principal objection offered by foremen to apprentices in the shops is the time which must be spent with beginners. With adequate shop instruction the foreman is relieved of this. The boy is given assistance as soon as he enters the shop and is made productive at once. It has been demonstrated that where you have twenty apprentices in one trade in a shop the increased output of the boys brought about by a practical instructor will amply justify the employment of a shop instructor.

In the discussion which followed, F. W. Thomas said that it is absolutely essential for boys in modern shops to have some one to direct their work as the foremen are too busy to pay attention to them. C. W. Cross mentioned the tendency at the present time of increasing the number of specialists and decreasing the number of all-around mechanics, stating that the apprentice system tended to create more men of the latter class. The proper training of the boys during the first year is more important than the value of their services.

An apprentice instructor of the Pennsylvania who was present stated that they had organized their apprentice system about three years ago at Altoona and that this year they had 277 at Altoona and schools at Philadelphia, Bloomington and Harrisburg. They are given four hours' instruction each week —two in drawing and two in recitation work. They are required to be there every day. W. T. Gale, of the North Western,

J. Will Johnson, of the Pyle-National Electric Headlight Co., and Geo. E. Johnson, Chief Electrician, C. & N. W. Shops.

W. T. Gale, Fourth Vice-Pres., General Foremen's Assn., and T. J. Mullen.

stated that their system was similar to others except that nothing was compulsory. The shop demonstrator has the apprentices under his jurisdiction. A great deal can be done by a little personal interest.

Shop Schedules.

This subject was covered by a paper by Henry Gardner of the New York Central and a committee report signed by L. A. North, Geo. C. Bingham and Henry Gardner. The following are extracts from Mr. Gardner's paper:

The usual argument made by the railroad officials against the adoption of these up-to-date principles is that the cost of clerical or non-productive labor is much greater than the benefits derived and money saved. These objections have been entirely disproved and overruled at the West Albany shops of the New York Central on account of the low cost of clerical help and the simple and practical nature of the work.

At West Albany a leading man is detailed to supervise the manufacture and delivery of all material to outside points. Such work is not dated or scheduled and it can be run through a shop using the scheduling system just as easily as an extra or special train may be run over a division without altering existing timetables.

The schedule office should be centrally located, preferably in the center of the machine shop and close to the foreman's office. One competent man with shop experience and an assistant for office work and checking is all the force required with this system to route and schedule successfully all the principal operations and material for repairing 90 engines a month. If the shop is a small one not requiring the full time of a special man for this work the forms used may be made out by the foreman or sub-foreman.

The first step in introducing this system is to prepare route sheets showing the course of all the material to be scheduled through the various departments. The second step is to determine the number of days to allow engines to remain on pits while undergoing each class of repairs.

Schedules must necessarily be flexible but once a schedule is made out for an engine it should not be revised unless there

is a complete change in the nature of the repairs. The condition of the shop and the demand for the power will, of course, influence the selection of a proper schedule. The best way to determine the number of days allowed is to average the days on pits for each class of repairs for several years back; then, to start with, take off two or three days from these figures to represent the increase in efficiency due to the improved methods.

In many cases small repair cards are used for still further extending dates to gang bosses and job foremen. These are made out in the foreman's office and copied from the large repair card issued to that shop. All repair cards are made out by the schedule clerk from the constant sheets already described and each repair card has its corresponding constant sheet; the only difference between the constant sheet and the repair card is that the former carries simply numbers, as already explained, and the latter carries the actual dates. All repair cards should be returned to the schedule office for record and file after the engine goes into service.

Too much importance cannot be attached to the proper supervision of the engine when stripped since the list of scheduled material depends upon the report made by the stripping gang foreman who should see that no unnecessary parts are removed and should make careful notes as the work progresses stating which parts should be repaired or renewed. This record should be sent to the schedule office and from it the repair cards will be made out. No repair card can have the full confidence of all concerned unless it is based upon exact conditions. The Master Mechanic's Report of repairs necessary should be made out and sent to the shop superintendent as usual, and while the engine is still in service.

The dispatch board is the key to the whole situation in the schedule office. It is simply a board, about 3½ x 4½ ft. carrying a "T" square slider. On the back of this slider is pasted a paper strip carrying the names of all the materials and operations scheduled. On the slider at West Albany there are 73 items listed under the several departments concerned. The board proper is covered with paper ruled into small squares which contain the numbers of the engines scheduled. There are about 30 rows of horizontal squares, one for each day in the month, and 73 rows of vertical squares corresponding to each item or group of material or operation as listed on the slider. It is now plain that we can readily stamp up the engine numbers in whatever little square comes in line with the date a certain piece or operation is required to be finished or delivered. When all the engine numbers are stamped upon the board in their proper squares the schedule clerk can see at a glance just where each part should be each day, when it should leave and where it should go. He can also tell when a piece is delayed in any department and how many days it is late according to the schedule.

There is no information on the dispatch board which is not carried somewhere on all of the printed forms but the board record is a great time-saver through its ability to present quickly all of the data in a convenient form; it is also of great service in apportioning the work so as not to overload any one department. The schedule clerk can optionally throw the dates ahead or back to better suit the congested conditions. The board record is also valuable when drawing off data for platting curves showing the progress of the work.

When making out the daily delay reports the "T" slider is placed on the line for the day in question and by reading along the whole length of the line, first the engine number and then the material or operation, the entire report can be made out in a few minutes. Since all of the delays are posted conspicuously on the board in red ink, a preponderance of red shows at once which department, if any, is weak. The total time required to stamp upon the board all the operations and material for one engine is, for two persons working together, about eight minutes. The question is frequently asked. "How about the apparently large amount of clerical work required to find and assign all of the many dates required?" In reply we say that the "system" is worked out in the office as well as in the shop; all of the forms and the methods of filling them out are carefully systematized so as to make a minimum amount of writing and figuring.

A simple slide rule is used for finding the dates. This calendar rule carries on its back the days of the month for a six months' period, Sundays and holidays omitted. The slider carries the consecutive numbers from 0 to 31 which represent the constants found on the schedule sheets and already described. When once examined this little rule is found to be very easy to understand and operate and by its use the time for writing on the repair cards all of the 278 dates required for one engine has been cut to 18 minutes for two persons working together; one to read the rule and the other to write down the dates. Every six months the rule must be recovered with the paper strips carrying the dates; the slider always remains the same.

Blackboards are used in the shop in nearly every department for conveying the dates directly to the workmen interested; about 30 are now in use. These boards are ruled into columns and horizontal spaces having in words "Engine No." and "Date Wanted" at the top of the columns. On some boards it has been found convenient to put on the letter indicating the erecting shop wing where the engine is located and also the initials of the man to whom that particular job is assigned. The dates and engine numbers are all chalked up on the board by the shop foreman or his clerk as fast as they are all received from the schedule office.

The men work to the blackboard dates, they are not at all interested in the date the engine leaves the shop; it is sufficient for them to know when their particular product is wanted. When the work is finished the workman or job foreman is only too willing to cross off the dates on the board.

The blackboard is simply an added convenience and a time-saver so that a workman can see instantly just what jobs are ahead and can figure so as to apportion them to the best advantage. It is a great incentive to the men to be constantly confronted with their dates and an engine number not crossed off on the date when the part is due is apparent to all foremen and inspectors.

After a trial of 15 months this system has helped bring about many beneficial results. The shops are now more equalized; departments under or over supplied with men have been reorganized so that they are in harmony with the entire plant. A better feeling prevails in all departments; men are not unexpectedly called up to work at night, their work is laid out for them each day and they see that it is done on schedule time if they wish to avoid delay marks and consequent censure.

This system may be used as successfully under piece work as with day work compensation. In fact, the piece workers like the "system" because they now get more work and it comes in proper order; for days ahead they know about how much they can make and this regularity is gratifying.

Another surprising benefit comes from the effect on the men of having the work laid out for them each day. The dates represent jobs and any man will work to the best advantage when he is given a specified job or task to finish within a stated time. A man who is constantly "jacked-up" by a foreman cannot do his best work and is not in the humor to do it if he wants to and the days of relying upon the energy and force of any one man to get results by constant driving are passed.

The foremen praise the system since it relieves them of unexpected censure and when the blame is placed it hits the right man and he always knows it is coming. The general foreman's duties are now much less complex. Under the old methods he might go from one department to another trying to fix the responsibility for delays; some will tell him one thing and others another, but now the daily sheet tells him just what is holding the engine and which department is to blame. No system can take the place of foremen but this system can take

Ninth Annual Convention Banquet
International Railway General Foremen's Association
White City Casino July 15, 1913
Chicago

Annual Dinner of the General Foremen's Assn. at the White City.

the place of endless questioning and running about, allowing the foremen to get in touch with their men and answer questions kindly and patiently.

The conclusions of the committee are as follows:

The aim of the largest percentage of the railroad shops today is, to turn out the largest output of good work in the shortest possible time. This can be done by the use of a schedule that can be altered by the shop management as the conditions require and by not being held to first figures submitted. Quite often to give any special engine preference means the loss of two or more deliveries that could have been completed had the work been allowed to go along the regular channels.

We are of the opinion that a shop schedule worked out along these lines will increase the output very materially, conditions however, at various places will necessarily be met with and changes made to suit. One in particular is the advantage the shop that has established a manufacturing plant for finished material so that it is not necessary to rob some engine that is nearly completed to send such part to some other point.

On Thursday afternoon the members were taken out to the shops of the Chicago & North Western on a special train.

Driving Box Work.

Papers were presented on this subject by C. S. Dickert, C. N. Newman and G. H. Logan. Mr. Logan's paper went into the subject very fully, extracts of which follow:

The importance of keeping binders tight in frame, jaws and wedges set up so as to preclude possibility of any other than intended vertical movement cannot be too greatly emphasized.

Special attention should be given left main driving boxes on right lead road engines as this box is subjected to harsher shock from piston thrust than the right one, as, when engine is working in forward motion and steam is admitted to left front cylinder port, left main driving box is against front jaw and a very little clearance between wedge face and box means a pound at this point. This condition also exists when steam is admitted to left back cylinder port as at this time box will be found forced against back of jaw and must move ahead to front of jaw when steam is admitted to back of cylinder.

Driving box troubles are more frequent on engines having underhung springs than those with springs on top of frames, not because the difference in suspension causes excess wear or strain, but because the wedges and wedge bolts of an underhung spring engine are neglected in service.

The correct adjustment of wedges is an important factor; on the road the average engineer takes advantage of time at a meeting point or a stop of a few minutes for any reason and, spotting his engine with right crank pin slightly in advance of top quarter, he loosens nuts on wedge to be adjusted, gives engine enough steam to pull drivers against front jaws, or if brakes back of drivers, sets his drivers, and pries up wedge with small bar, then tightens wedge nuts and if parts are properly machined he has set wedges up under ideal conditions, and it should give him no further trouble.

We say ideal conditions for this reason: Engine has been working and all parts have warmed up to normal maximum temperature which assures a normal expansion of parts which is very desirable in adjusting wedges properly so when an engineer reaches a terminal with wedges reported as needing setting up, same should be done as soon as possible in order to obtain the benefit of conditions mentioned.

We use babbitt metal on hub side of S. & N. W. driving boxes and in addition to dovetail recess use a number of brass plugs which are cast a trifle full of 7/8" diam., are 1 5/8" long with 3 grooves 1/8" wide and about 3/32 deep at one end. These plugs are driven in box and serve a double purpose: First, to help hold babbitt to face, and second: Plugs are spaced so that in case babbitt breaks and loses off, plugs cover wearing surface on driving wheel hub and keep box itself from hub temporarily, and as most of our boxes are cast steel, keeps hubs from being cut for some time. In addition to the brass

plugs on the hub faces of our boxes, we have woven copper wire criss-cross around these plugs and have found it very helpful on our division in retaining babbitt and experience less trouble from sections of plate breaking and dropping from box.

We have a large number of our engines equipped with the Markel removable hub plates, a very ingenious device which makes lateral troubles on these engines a matter of small import as it is possible on these boxes to remove plates and substitute plate kept in stock in the remarkably short time of 1½ hours per box, or working two men on the same pair of wheels, 1½ hours to take up lateral in a pair of drivers.

Another source of trouble we experience is the breaking of shoe and wedge flanges on some classes of our power. Of course there is a logical reason for this and in the majority of cases it will be found that the driving box is of insufficient width and does not have flange bearing enough on frame jaws and thrust of box tends to force shoe and wedge through jaw naturally breaking off flanges.

Our road is making what we call the flangeless shoe and wedge installation on all of its modern power, and on engines so equipped broken flange trouble is a thing of the past as there are no flanges to break. This installation, however, is not faultless as it transfers wear from shoe and wedge flanges to the driving box flange and will decrease its life to some extent, while, on the other hand, plates applied to sides of frame jaws will prevent any possible frame wear at this point, and is, therefore, a point in favor of flangeless shoes and wedges. If you have broken flange trouble from cause assigned, insufficient box flange bearing, you can overcome or reduce breakages to a minimum by the use of a generous fillet in your shoes and wedges and by planing the side surface of both shoe and wedge on hub side 3/64 lower on part that extends beyond jaw faces. This takes all torsion from box thrust and overcomes tendency to force box through jaw as impact is entirely on flange which in turn is forced fairly against side of jaw. I beg those of you, however, who are contemplating a change in driving box patterns to make sure of sufficient flange bearing. And as a suggestion, why not make at least the outer wedge flange of your new driving box the same taper as your wedge and be insured of a full jaw bearing. If your jaw taper is the same as ours, $\frac{1}{16}$" to the foot, it means something in a box 18 or 20 inches long.

I am on record on the Chicago & North Western as being opposed to liners on driving boxes at shoe and wedge face. I am when liners in consideration are of cast brass ⅜" thick, held by 5 rivets, but I would endorse a bronze liner of sufficient hardness, securely fastened to faces of box. With suitable liners, a cast steel box after once being machined, needs only to have its several removable parts, viz.—brass, hub plates and liners of babbitt, brass or bronze preferably, renewed to last indefinitely and maintain its original dimensions.

Grease lubrication fed to top of journal and tongue on cellar interlocking with grooves at lower end of box at cellar opening which keeps box from spreading, are radical and commendable departures from usual practice.

In conclusion, I believe thorough service is paramount to rapid and questionable methods which hurry engine through shops in remarkably short time, with results that very often engine is returned in equally remarkably short time.

C. S. Dickert stated in his paper:

The first and most important step is to perfect your organization. Get a good man lined out on this class of work, get him interested in the work, and you will get results. Have a system of handling the work from one machine to another; keep regular men on the machines if possible, and if this cannot be done, always use the same man on the job, that he might become efficient in this particular class of work; keep in touch with your men, go around and talk to them and see that they have the proper tools and that the machines are kept in good order.

C. N. Newman divided the subject into four parts, covering:

First. "Method of machining driving boxes, shoes and wedges."

Second. "An economical machine grouping for this work."

Third. "A good method to fit up shoes, wedges and boxes and square the engine."

Fourth. "Methods or rebuilding wearing surfaces."

For information on these subjects he obtained data from a number of leading railroads of the country, giving some of

Annex Exhibit Room at the General Foremen's Convention.

Main Exhibit Room, General Foremen's Convention, Looking South.

their methods and practices, also an idea of the time of performing some of their principal operations.

In the discussion on driving boxes many members told of the method being employed on their own line and this resulted in a fruitful interchange of ideas.

Engine House Efficiency.

The paper on "Engine House Efficiency" was presented by W. Smith, extracts from which follow:

The aim of the roundhouse management should be to make the highest possible mileage between shoppings and engine failures, to minimize the time out of service due to handling and repairs, to keep the cost of handling and repairs down to the lowest possible figure, and lastly, to furnish engines on time.

That local conditions largely determine the cost of repairs is shown by the fact that the cost of repairs per mile in this country varies from 4 to 16 cents.

The scrap value of some of the material removed from locomotives amounts to considerable. Hence workmen should be required to bring the scrap material to the storehouse in exchange for the new.

Nothing about the roundhouse should be allowed to go to waste—even dirty waste can be reclaimed, and condemned air hose can be made into throttle gland packing.

The importance of a well stocked storeroom cannot be overestimated. When repair parts are not in stock, the broken parts have to be expensively patched, or new ones have to be made at great expense, or else the engine is held out of service while the repair is sent for. The stealing of parts from one engine for another which is a fruitful source of trouble and expense, is also an outcome of lack of material.

The problems of engine failure largely concerns the human element. Hence, to keep down engine failures, the human element must be controlled, and that means good discipline. Discipline when properly administered will do much to eliminate failures. In some cases, friendly censure or words of caution may have the desired effect, in other cases it may be necessary to resort to suspension.

In order to have the desired effect on the men, a daily report of failures on the division should be posted in a place accessible to all. Most roads compile a record by divisions; it is a summary of engine failures from each cause on each division, and for the whole road. In order that comparisons may be made, the total number of failures and miles run per engine failure is shown for the previous month, and the corresponding month of the previous year. This report should also be posted, as it has a tendency to create a feeling of rivalry between the men of the different divisions, and it gives the men to understand that they are in a measure responsible for results.

When a number of failures occur from the same source, it is sometimes possible to prevent a recurrence by taking certain precautions. As an example of this, a certain road had an epidemic of engine failures due to blow-off cocks sticking open. In most every case it was found that a piece of a staybolt or the burr from the head of an arch tube, kept the valve from closing. Failures from this source were eliminated by requiring the mechanics who removed staybolts or arch tubes to fish out the pieces from the mud ring, and deliver them to the foreman.

In order to get maximum mileage from engines between shoppings, all inspections should be made in a thorough manner, and all adjustments and repairs should be given immediate attention. Aside from this, there are certain features with regard to locomotive maintenance, which, if controlled, will greatly prolong the life of an engine between shoppings. The first is unnecessary or excessive flange wear of driving tires; in some cases this may be overcome by re-spacing tires or putting engine in tram. The second is excessive lateral motion in drivers; this may be prevented to some extent by keeping lateral well taken up in engine trucks and trailers. The third is improper condition of driving boxes; this may be prevented to a large extent by well maintaining shoes and wedges. The fourth is lost motion in rods and connections; this is controlled to some extent by keeping driving boxes in proper condition. It is also necessary to renew a rod or knuckle bushing occasionally, and to keep the main rod brasses reduced.

The importance of a good organization in the engine house is the keynote of the whole situation. Even when the conditions are favorable, and modern facilities are provided, if the organization is not on a sound basis, the results obtained will be inefficient.

By organization is meant "the selection and assignment of men, and the distribution of responsibility for results." Hence, in an efficient round house organization each foreman and each workman should have his duties clearly defined, and should be given to understand that he is responsible for the work he performs.

An organization to be effective must also provide for the loss or transfer of workmen or foremen—that is, there must be men trained for every job so that when absences or vacancies occur, the operation of the round house will not be affected in the least.

Then the selection of men should be given some attention, and not by the common method of "Hiring and firing."

An organization to be effective must have enough supervision to relieve the foreman of too much detail work. There is no question but that the inefficiency of many round houses is due to lack of supervision.

The round house foreman should be directly responsible to the master mechanic for results, but the latter should not interfere with the actual supervision of the engine house, as such a practice is sure to spoil the authority of the foreman with his men, and consequently the organization as a whole is weakened. The master mechanic should communicate all instructions, suggestions and criticisms directly to the foreman, and not to individual workmen or assistant foremen.

After an efficient organization has been perfected, the problem that confronts the foremen is to maintain it. This is a question which largely concerns his personality. He should be a firm disciplinarian, and at the same time should have the good will of the men. He should be quick to think and act, and above all should be a keen observer. It is important also that he should be able to key up the organization when the power is badly needed. A spirit of loyalty among the men is one of the greatest aids to efficiency in the engine house, and that can sometimes be brought about by an occasional word of encouragement.

The aim should be to operate the round house on the basis of a machine. All movements of the locomotive, from the time of its arrival on the round house tracks until its departure, should be given the closest attention. The longest delay before an engine is run in the house ordinarily occurs at the clinker pit. Hence the need of especially close supervision at that point. If enginemen are educated to bring in engines, with plenty of steam, full of water, and not excessively heavy fires, an efficient gang of fire knockers can cut the delay down to a surprisingly low figure.

The question of a detailed inspection is a very essential one, and to get best results the work should be specialized as much as possible. In the ordinary engine house, handling both freight and passenger power, there should be an engine inspector for passenger engines, another for freight engines, a boiler appliance inspector, an air brake inspector, a front end and ash pan inspector, and a boiler inspector. The duties of each inspector should be clearly defined, either by sheets of instructions or otherwise, and they should not be called upon to help out on work outside of their regular duties. One road has gone so far as to furnish inspectors with printed instructions.

Whether inspectors should be required to do any of the actual work of making minor repairs or adjustments, found necessary, depends on conditions. Ordinarily, engine inspectors can replace missing cotter keys in the time it would take them to make out a written report of it. Hence in most cases it is advisable to require them to put in cotter keys. Some round houses provide the engine inspector with a helper whose duty is to follow along and tighten loose nuts, put in cotter keys, etc.

Ordinarily, a considerable part of the time of mechanics is consumed getting together necessary tools for the work. In order to facilitate matters, some of the mechanics should be provided with portable tool boxes, which should contain all the tools for the special work they are assigned to. This tool box can easily be wheeled to the place where the work is to be done, and obviates the need of workmen running back and forth to their tool drawer or to the tool room for necessary tools. These boxes are also convenient to stand on for some kinds of overhead work.

In order that the round house foreman may get in rapid communication with various under-foremen and others at large terminals, there should be a telephone system between master mechanic's office, round house, clinker pit, coal chute and other points that local conditions will determine.

In every large round house more or less time is spent by the different foremen looking for each other when something important turns up. As an aid in this direction an air whistle can be located in some convenient place in the round house, and a suitable code of signals can be arranged. This system of signaling has been installed in Los Angeles engine house of the Southern Pacific, and with splendid results.

Cleanliness, light, and good ventilation are most important factors in engine house work; they not only keep the workmen in better condition for his duties, but they make him more alert. In the first place good natural lighting should be obtained by keeping the windows clean. The best method of keeping windows clean is to use a window swab into the brush of which is discharged a stream of warm water furnished from the hot water line by a suitable hose. White washed walls have a tendency to lighten up an engine house. Hence, once a year or oftener the walls should be white washed with a spraying machine operated with air.

A round house that makes no provision for the safety of the men have overlooked one phase of the subject of efficiency. Even when conditions are the best there are more or less dangers connected with engine house work, and it is only by eternal vigilance that they can be prevented. Care should be taken to have boards a good fit around the drop pit, and they should be put in place immediately after the pit has been used. Engines should be properly blocked with chains or specially made shoes of wood, and no engine should be moved unless proper signals of warning are given, so that a workman in a concealed position has time to take warning. In order that there will be no danger of blow-off pipes coming off while steam is being blowed into the blowing down line, the connections should be examined occasionally, and if connections are worn they should be renewed. For safety and other reasons only authorized persons should be allowed to move engines.

It is absolutely necessary that an engine house office should have a good filing system, so that any records, blue prints, or instructions can be readily located and referred to. Records of all periodical examinations and tests should be kept in as brief and comprehensive a manner as possible. Reports to the master mechanic should be made out on standard forms, or on specially prepared mimeographed sheets. In fact, all clerical work should be systematized as much as possible.

In order that assistant foremen may have a place to do their writing and make out their reports, a small office should be located at some convenient place in the engine house. It need not be larger than to contain a desk and a stool. All engine houses on the New York Central are provided with these offices, and they are considered indispensable to the operation of the engine house, as workmen come to this place for orders and instructions.

EXHIBITORS AT THE GENERAL FOREMEN'S CONVENTION.

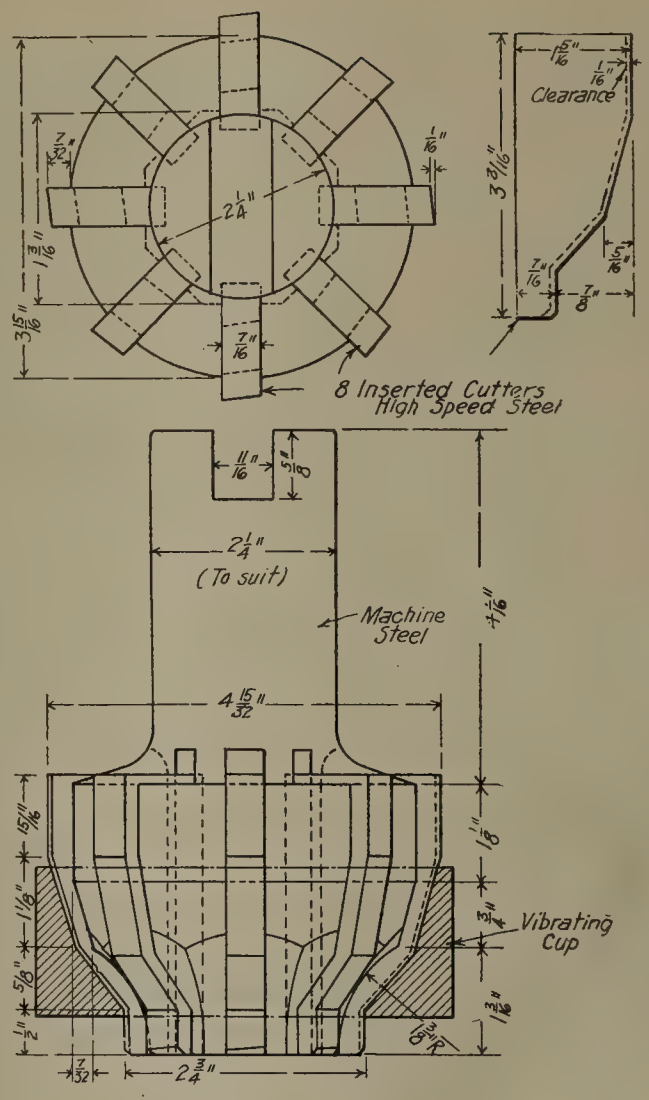
The concerns having exhibits at the General Foremen's convention are as follows:

Anchor Packing Co., Philadelphia, Pa.
Ashton Valve Co., Boston, Mass.
Barco Brass & Joint Co., Chicago.
Bausch Machine Tool Co., Springfield, Mass.
The Bettendorf Co., Bettendorf, Ia.
S. F. Bowser & Co., Ft. Wayne, Ind.
Buda Co., Chicago, Ill.
Carborundum Co., Niagara Falls, N. Y.
Celfor Tool Co., Buchanan, Mich.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Crane Co., Chicago.
Crucible Steel Co. of America, Pittsburgh, Pa.
Detroit Lubricator Co., Detroit, Mich.
Edna Brass Co., Cincinnati, O.
Emery Pneumatic Lubricator Co., St. Louis, Mo.
Equipment Improvement Co., New York.
Flannery Bolt Co., Pittsburgh, Pa.
Goldschmidt Thermit Co., New York.
Garlock Packing Co., Palmyra, N. Y.
Hunt-Spiller Mfg. Corp., Boston, Mass.
Independent Pneumatic Tool Co., Chicago.
Jerguson Mfg. Co., Boston, Mass.
Jenkins Bros., New York.
H. W. Johns-Manville Co., New York.
Keystone Lubricator Co., Philadelphia, Pa.
Leslie Co., Lyndhurst, N. J.
Locomotive Superheater Co., New York.
McQuay-Norris Mfg. Co., St. Louis, Mo.
Manning, Maxwell & Moore, New York.
Monthly Official Railway List, Chicago.
Burton W. Mudge & Co., Chicago.
Nathan Mfg. Co., New York.
National Boiler Washing Co., Chicago.
National Machinery Co., Tiffin, O.
Ohio Injector Co., Chicago.
Pilliod Co., New York.
Pyle-National Electric Headlight Co., Chicago.
Racine Tool & Machine Co., Racine, Wis.
Railway & Engineering Review, Chicago.
Railway & Locomotive Engineering, New York.
Railway List Co., Chicago.
Railway Master Mechanic, Chicago.
Jos. T. Ryerson & Son, Chicago.
Simmons-Boardman Publishing Co., New York.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Strong, Carlisle & Hammond Co., Cleveland, O.
U. S. Metallic Packing Co., Philadelphia, Pa.

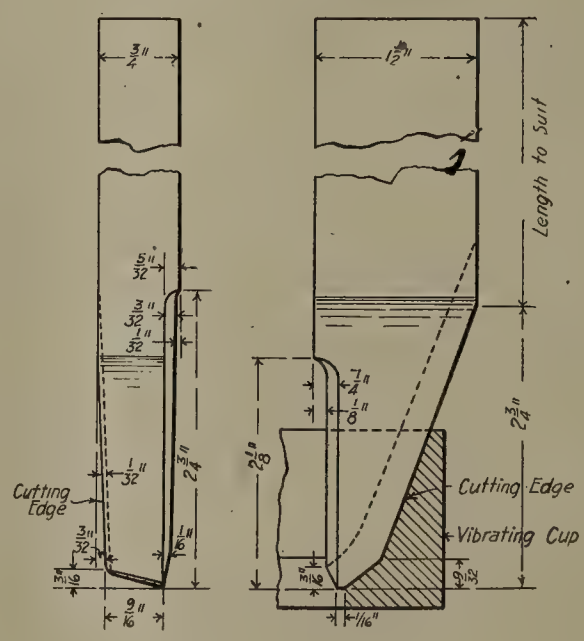
MACHINING VIBRATING CUPS.

The sketches show a method of machining the vibrating cups used in connection with the U. S. metallic packing. I have seen this work performed in many various ways; the time taken ranged all the way from seven minutes to over an hour. The first operation is facing off the bottom or joint face. This is done first, for the reason that if any defects show up in the castings at all it is on these faces that blow holes appear. And as the time taken to face this part is but two minutes, the loss is not so great should they have to be rejected. After a batch has been faced off in a universal chuck they are then chucked for the boring operation. The castings being thin at the largest diameter are rather hard. The method adopted is as follows:

1st. Face 50 vibrating cups as shown, the time taken being approximately 100 minutes. 2nd. Bore out 50 vibrating



Machining Vibrating Cups.



Machining Vibrating Cups.

cups as shown, the time taken being approximately seven and one-half minutes per piece. This time does not include bolting a 12" universal clutch down to the table of the 24' turret head boring mill. The tools used are shown in the sketch. The first tool is a high speed steel bar ground to the proper angles and made so that the boring of the small diameter is accomplished by the back edge of the cutter. This is forced over to a stop on cross-rail, then forced by hand in opposite direction to another stop, until the piece is roughed out sufficiently to allow the finishing reamer to complete the work. This reamer is made of inserted high speed steel cutters, driven in tightly. This method of holding the cutters in place has been found quite sufficient. These devices are in use on the Temiskaming & Northern Ontario Ry.

The method may be open to criticism; if so, let us have it. The cups may be machined much faster in some shops, and that is what this contribution is for; to bring out the best methods.

OBSERVER.

TOOL FOREMEN'S CONVENTION.

The fifth annual convention of the American Railway Tool Foremen's Association was held at the Hotel Sherman, Chicago, Ill., July 22, 23 and 24, 1913. The meetings were presided over by President J. Martin, tool foreman of the Big Four at Indianapolis. In the annual president's address Mr. Martin emphasized the handling of scrap tool steel and urged the members to study shop conditions with a view of devising new tools. The convention also listened to an address by E. W. Pratt, assistant superintendent of motive power of the Chicago & North Western, in which the importance of the tool room was strongly emphasized.

Five subjects were covered by the meetings, contributions to each subject being made by a number of members. In addition the General Electric Co. gave a demonstration of the work of the electric furnace at its Chicago warehouse on Wednesday afternoon.

Reclamation of Scrap Tool Steel.

J. J. Sheehan, N. & W. Ry., Roanoke, Va.: In the utilization of scrapped tool steel it is not to be understood that it is acceptable only for certain shapes and sizes of tools. On the contrary, it is necessarily the aim to recover and employ such materials for the ordinary every-day needs of the shop. For illustration, it might apparently take less time to use steel from the bar for an inserted blade cutter that could be ground to a fit rather than to use a forged piece, which would require considerable dressing, as the forged steel could be used for purposes requiring little if any dressing to accomplish the required fit.

For example, at a certain plant 6500 lbs. of tool steel has been purchased during a certain period, and the average cost has been, say 50 cents per lb. All of this material was worked into tools, and having served the desired purpose, it was found that the sum of the parts turned in as scrap amounted to 2600 lbs., or 40% of the original quantity purchased, or, taken at the value of the purchase price, represented $1300.00.

As tools become too short or unfit for further service, they are placed in the scrap bin provided for the purpose, corresponding to the number on the tool. When a sufficient quantity of scrap tools has been accumulated, it is then sent to the smith shop, weighed, receipted for and placed in bins in the steel workers' section, labeled Grade 1, Grade 2, Grade 3, and Grade 4, corresponding to the grade of the scrap. This department is equipped with a furnace that will maintain a heat of 2500 deg. F. with a preheating chamber attached suitable as well for annealing purposes. There is also a 1200-lb steam hammer for the work of the department.

When a sufficient quantity of scrap grade No. 1 has accumulated, it is placed in the preheating chamber of the furnace, and allowed to heat slowly and uniformly to a dark red 1000 deg. F.; the steel then being transferred, at the convenience of the tool smith, to the other chamber and brought to a bright red head 1550 deg. F. and forged to the required size. From 600 lbs. of scrap steel thus treated there were 500 lbs. of serviceable tools delivered to the tool room, at a reclamation cost of 5 cents per lb., and from the service rendered were the equal of tools made from the original bar; hence the reclamation value of the steel after deducting the cost of reclaiming, 5 cents per lb., was 45 cents per lb., or $225.00.

Of grade No. 1, 315 lbs., were worked into cutters for Davis Boring Bars, to bore 7-in. wheels. After these cutters had served to the limit, there were 250 lbs. of scrap steel annealed and redressed for 6½-in. cutters for boring bars of the same make at a reclamation cost of 5 cents per lb., representing a reclaimed value of $112.50. After having served to the limit for the 6½-in. wheels there was 180 lbs. of scrap which was again redressed and used for 6-in. wheels, with a reclaimed value of $81.00. After the limit of boring tools was reached, there were on hand 150 lbs. of pieces ⅞x2x2½-in., which were sent to the smith shop and forged into turning tools ½x1x7-in. long, with a reclaimed value of $56.25.

After a number of re-cuttings for the 1¼-in machine, there were on hand 200 lbs. of scrap dies, which quantity was annealed and reworked for the 1-in. machine at a reclamation cost of 2 cents per lb., or a reclaimed value of $95.00. After this service, there were on hand 150 lbs. scrap dies, which were then worked into tool holder bits, of which there were 50 lbs. ⅜x⅜x4-in at a reclamation cost of 5 cents per lb., or a reclaimed value of $22.50.

From 786 lbs. of grade No. 2 scrap placed in service at an original cost of 17 cents per lb. there was 437 lbs. of scrap annealed for reworking at a reclamation cost of 2 cents per lb., with a reclaimed value of $65.55, the tools consisting chiefly of taps and reamers; taps ranging in size from 4-in. diameter down. 4-in. taps were reworked to the next smaller size, say 3¾-in., and so on down the line. On 1¾-in taps for flexible staybolts 1¾-in diameter, the threads were removed and used for reamers for the same purpose.

From 1,147 lbs. of grade No. 3 scrap put in service at 12 cents per lb., there were reclaimed 534 lbs. at 2 cents per lb., or a reclaimed value of $53.40, consisting of punches, punch dies, rivet sets and flue expander pins.

Thus it will be seen that by pursuing a systematic recovery of scrap tool steel and following a plan of utilizing material for the smaller sizes and shapes, for which it is perfectly applicable, we must find an opportunity under ordinary conditions to save a great deal in the amount of tool steel in the aggregate, and in the end effect a net saving which would seem to be well worth the time and attention.

E. R. Purchase, B. & A. Ry., Springfield, Mass.: We take the largest wheel lathe tools of high speed steel and keep drawing them down until we reach ⅜ inch or ½ inch square, for use in the tool holders.

We have tried to use tire steel for rivet snaps with indifferent success, some working nicely and some giving no service. We have used some machinery steel for forging dies but find that a carbon steel for forging dies is economy.

Superheater Tools and Their Care.

Fred Peterson, Colorado & Southern Ry., Denver, Colo.: We have what is known as the Emerson Superheater in our engines, which consists of 24 flues 5½ inches in diameter. When we first received these engines we experienced some trouble in keeping those flues tight, our chief trouble being at the front end. After looking into this matter very closely, we discovered that the flues were not beaded at the front flue sheet and this was the cause of some of the leaks. This was a hard matter to overcome without taking out the steam pipes and superheated tubes; but being compelled to do so, we turned the flues over, beaded and expanded them and our trouble was relieved. Later on we found that instead of removing the steam pipes to get those tubes out, we sawed the superheated tubes off and then pulled them out, thereby causing us to put a coupling between the steam pipe and the tubes, so this makes it easier for us to remove the superheater pipes inside the large tubes.

We found again that the feed pipe or checks in the boilers were close to the front flue sheet and the water striking the 4½-inch superheater tubes seemed to cause them to leak at different times. While this leak did not seem to have much effect on the steaming qualities of the engine, we found that it would be better to have the check placed back farther—30 or 36 inches from the front flue sheet, so the change and temperature of the water would not have such effect on the large superheater tubes.

In putting in those tubes we swage the fire-box end to fit a No. 30 copper ferrule. We roll them with a Standard boss roller, with five rolls in, and then after turning over we expand them with a sectional leaf expander, and the flue is worked practically the same as the standard two-inch flues in our other locomotives. We find that in using these rollers, it is not necessary, after the engine has been in service for some time, to roll those flues very hard, and merely the weight of the rollers will make the flue tight and give better results than heavy

rolling. The front end is also rolled, and we also use a prosser or sectional leaf expander after the flue has been turned over. By this means we seem to have no trouble in keeping those flues tight.

A. R. Davis, C. of Ga. Ry., Macon, Ga.: After describing the tools used on the Central of Georgia, Mr. Davis says:

We have not had enough experience in handling the superheater tubes for me to state what the expense is apt to be in maintaining the tools for this class of work, but from present indications I do not believe that it will be any heavier in generally used for the fire box end of the tubes.

Making Thread Cutting Dies.

Aug. Metz, Pere Marquette R. R., Grand Rapids, Mich. (Committee Chairman): Select the steel for the chaser as near the size as possible to avoid unnecessary machining. Cut the chaser from the bar to the required length, square one end, and drill a hole as necessary depending on the machine in which it is to be used. Place the chaser in the holder and remove all excess stock on the heel or the back face of the chaser. It is best to remove the metal to the center line of the chaser. The angle or rake of the front face or cutting edge of the die is important and dependent upon the grade of stock which the die is to cut.

If the chaser is to be used for cutting copper, brass or the like, this angle should be zero, or coincide with a line passing through the axis of the work. For cutting bar iron the angle should be six degrees; for steel or steel pipe the angle would increase to twenty-two or twenty-three degrees, making a hooked die. This can readily be seen from our lathe practice. The chaser is now stamped for size and numbered to designate the relative position in the cases and die head and is secured in the same ready to be hobbed or threaded. Before hobbing a reamer of proper size is passed through the blank chaser removing all surplus metal by concaving the cutting edge of the blank and leaving but one or two thousandths of an inch to be removed by the bottom of the hob or tap.

After being reamed a hob or master tap is placed in the vise of the machine and run through the dies from two to five times, depending on the size of the tap. After the dies are hobbed, the chasers are removed from the cases and all burrs are carefully removed and the chaser is ready to be tempered, the method depending upon the grade of tool steel used.

After tempering, the throat or entrance of the die should be ground to the proper rake or clearance. This should be done by a special machine for this purpose, otherwise by hand.

In threading a die of this type the cutting is all performed in the throat and the thread is completed by the first full thread encountered by the work, the remaining teeth only serving to feed the work and maintain the lead. From this it can readily be seen that the grinding of the chaser is very important so as to obtain the correct angle and proper clearing.

Mr. Metz also quoted from Mr. W. L. Ernst relative to shop practice at the works of the National Machinery Co.

J. B. Hasty, Santa Fe Ry., San Bernardino, Cal.: Dies, like all other cutting tools, must be made and kept in good condition to produce good threads. It is safe to say that one-fourth of all the bolt cutters in operation at present do not cut a clean chip. Most of threads are only ridges squeezed on the iron, which ruin the dies and in fact the whole machine.

G. W. Smith, C. & O. Ry., Huntington, W. Va.: A very important matter in preserving good dies is good oil. Any kind of bolt compound, or combination of waste oil is good enough, as a great many think. They do not figure on the poor thread and the quick destruction of their dies that is being accomplished. We do not claim that high-priced, skilled labor is necessary to operate these machines, but the common practice of placing a green hand, either man or boy, on a machine for a few days, until another job can be found for him, he not knowing, and in a majority of cases not caring, what becomes of the dies, is deplorable. In our experience, a good, steady man, after getting on to the job, is a very profitable asset to continue on the job. We feel impelled by a sense of duty to offer these suggestions to the association, as we believe a great injustice has been done by too little attention being paid to the abuses of this branch of machine shop practice.

We use the Landis dies and die heads, placed on machines on which were formerly used other style heads. In this connection I wish to state the Landis dies and die-heads gave good service when other forms of dies failed to do so. When cutting soft steel bolts, we ground our dies in every conceivable way without good results, until we got the Landis. Our make of dies would cut splendid threads on good iron bolts, but made a very ragged thread on soft steel, so our troubles were relieved after getting the Landis type on soft steel.

Forging Machine Dies.

B. Hendrickson, Chicago & North Western Ry., Chicago, Ill.: The process of making wrought iron and steel forgings by the use of a powerful machine and dies consists of four operations, viz.: A gathering of stock from bar, moulding into shape, welding and punching. Oftentimes one operation only is necessary to form a piece, then again all four may be required. The dies for doing this work have two functions to perform. They must be able to grip the stock and must contain recesses of such a shape that the desired forging may be produced in one or more operations, as the case may be. In conjunction with the dies, a plunger is used whose function is to upset the stock and force it into the recess of the die.

The nature of the work to which they are put determines the material of which the dies shall be made. Cast iron, being the cheapest and most easily worked, is very desirable, but can only be used where the demand for its product is not very great. Where many forgings are required, standard dies are cast steel. Oftentimes the forgings may be done in such a way that more wear takes place on one part of a die than on another. In such a case what are called sectional dies are used. The main body of such dies is made of cast iron and so designed that where the excess wear comes, this is borne by inserts made of tool steel. These inserts may be removed when worn beyond a certain limit and replaced by standard size, so the entire die does not have to be scrapped.

The material of which plungers are made depends both upon their size and the nature of their work. Nickel steel is the material to be used for heavy work while common tool steel or special plunger steel will do for lighter work. Where a punching operation is required, the brunt of the work should be borne by inserts made of air hardening steel or plunger steel. Provision must be made in the design of dies for the overflow of excess metal when the die recess is full. A vent should be made varying in size according to the weight of forging. This vent, of course, becomes unnecessary when enough pieces have been made to enable the foreman to calculate the exact amount of material required. Wherever upsetting is done by means of a hollow plunger, a vent should be placed at the bottom of the recess, to allow the air to escape which would otherwise be confined. Heating of dies from the hot stock does not affect their design. On large work, so much time is consumed in heating stock, that the die cools itself. This practice will not do in the case of small dies, however, as they work too rapidly. There are two ways of cooling, either with a jet of water or swabbing off the surface with oil. The former method should be avoided wherever possible as it causes the die face and plunger to check, thus decreasing their life.

The class of work turned out by means of forging machine dies can hardly be called exact, still it is very well able to meet the requirements of practically all locomotive forgings. The work may be said to be light as compared with what is turned out on the hydraulic presses and heavy as compared with the drop forge or Bradley Hammer. Good results can be expected wherever the work consists of upsetting and forming or any kind of jaw work which is within the capacity of the machine.

Chas. Helm, C. M. & St. P. Ry., Milwaukee, Wis., called

attention to the drawing of the die used in the Milwaukee shop on a four-inch Ajax machine for forging castle nuts.

The Form of Thread and Degree of Taper for Boiler Studs and Plugs.

A. M. Roberts, B. & L. E. R. R., Greenville, Pa.: I find upon investigation that ¾ taper is largely used on various roads. Regarding the form of thread, I would say that the U. S. Standard form, 12 threads per inch, is more preferable.

In regards to the mud plugs we find that there are different tapers on different roads, while some roads are 1½-in. taper in 12-in., others are 1-in. taper in 12-in. The tap manufacturers have a standard stock size tap which can be furnished to any road from stock sizes which are 1¼-in. taper in 12. Therefore, I would recommend a 1¼-in. taper in 12-in. for standard mud plugs.

Jas. E. Dosser, Southern Ry., Knoxville, Tenn.: Many of the leading roads have investigated the superiority of the new form, or U. S. Standard form, of thread and are using it exclusively. The following roads have adopted the U. S. Standard form of thread exclusively for boiler work:

Pennsylvania Railway Co., Louisville & Nashville Railway Co., Norfolk & Western Railway Co., Southern Railway Co., Central of Georgia, Delaware, Lackawanna & Western, Chicago, Rock Island and Pacific, International & Great Northern.

The Pennsylvania, after very carefully investigating the matter, as we understand, going into actual tests for more than a year, finally decided to abandon the old "V" form of thread for boiler work and substitute that of the U. S. form in its place, and our understanding is that the change was carried into effect in August, 1912.

As to the desirability of the U. S. Standard form of thread over that of the old "V" form, from our own point of view there can be no question, as the latter is not standard and there can be no fixed formula to which tools can be furnished, while in that of the U. S. Standard form, there is a formula to which tools can be made and duplicated indefinitely. Furthermore, the U. S. Standard form of thread gives much greater strength and life to taps and dies in use than that of the old "V" forms. There is also the advantage of re-tapping the old "V" form holes with the U. S. tap and replacing studs with U. S. form of thread without changing the size of the stud.

There is, and will be for some time to come, some prejudice against changing from an old to a new system, but in our opinion and in intercourse with other railway mechanics, we believe this prejudice is fast breaking down, and it will not be many years before the U. S. Standard form of thread will be used practically universally for boiler practice.

Touching on the question of tapers, we find that there are two tapers used by tool manufacturers, namely ¾-in. and 1¼-in. taper per foot for mud plugs. We find that the ¾-in. taper per foot is most generally used for boiler studs. Therefore, such being the case, we are led to believe that the ¾-in. taper for studs is the most practical in use.

Daniel Freyler, Illinois Central Ry., Memphis Shops: I recommend the "V" thread for boiler studs and plugs. It has a greater cross-section than the U. S. Standard, with flat top and root of thread for an equal number of threads per inch, which gives an exaggerated outline of the two forms of thread. The depth of the U. S. Standard thread is not as great as the "V" thread and is narrower at the base. However slight the difference may be, yet it is sufficient to reduce the area of the cross-section of the thread and as a result, the shearing strength. It may be objected that by reducing the depth of the thread the area of the screw at the root of the thread is correspondingly increased, hence the tensile strength of the stud is increased. This is true, but this objection is met when it is demonstrated that as the thickness of the boiler plate ordinarily is less than the diameter of the screw, in consequence, the principal strain is on the thread, not on the core of the screw. The result is that if the cross-section of the threads engaged is reduced, the efficiency of screw or plug is reduced; therefore, since the cross-section of the U. S. Standard thread is less the "V" thread for the same number of threads per inch, or pitch, then the "V" thread is the thread to be used as it offers the greater resistance to the shearing strength on the thread.

The "V" thread adapts itself more readily to the slight variations in the angle of the thread and still makes a tight joint.

P. W. Briggs, Delaware & Hudson R. R., Carbondale, Pa., Shops: The Delaware and Hudson use "V" threads 12 per 1-in. on both studs and plugs with a taper of ¾-in. to 12-in. for studs and 1¼-in. to 12-in. for plugs.

H. C. Wilson, Southern Ry., Spencer, N. C.: I am in favor of the United States Standard form of thread, because as it does not have a sharp point it will not wear so fast, and, therefore, retain its size and form much longer than the sharp "V" type, and will make just as tight a steam fit as the "V" type will. I have found that a "V" form tap or die will soon wear off at the point of the thread losing its size and form, causing trouble from tight or loose bolts, whichever the case may be.

W. J. Eddy, Inspector of Machinery, Rock Island Lines, Chicago, Ill.: My recommendations for a standard form of thread and degree of taper for boiler studs and plugs are as follows:

Number of threads per inch for all boiler work....12
Form of thread.....U. S. Standard
Taper, plugs and fittings.....¾-in. per foot
Wash-out plugs.....1¼-in. per foot

The above is the present Rock Island Standard.

Election of Officers.

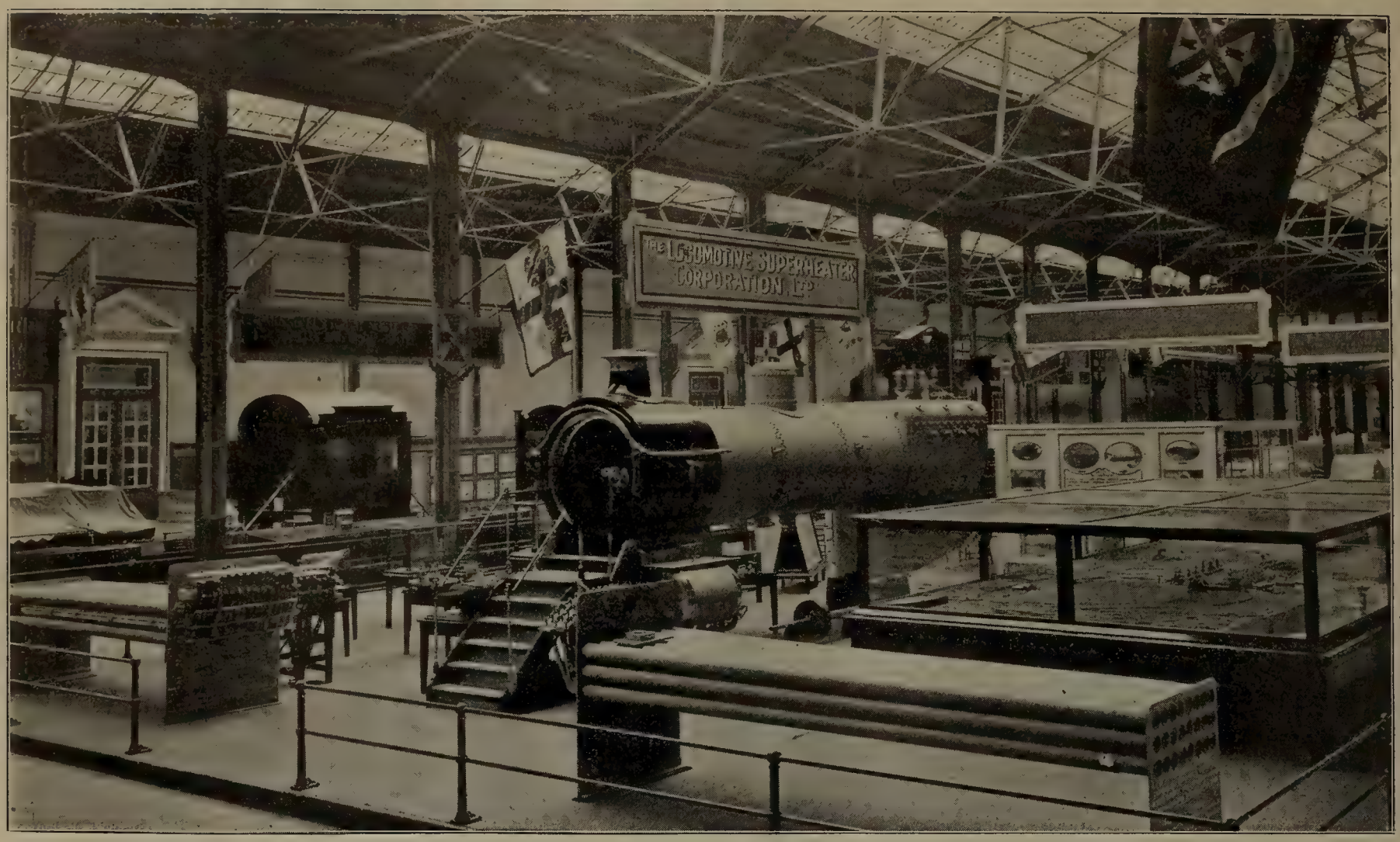
The officers for the coming year are as follows: President, A. M. Roberts, Bessemer & Lake Erie, Greenville, Pa.; first vice-president, Henry Otto, Atchison, Topeka & Santa Fe, Topeka, Kan.; second vice-president, J. J. Sheehan, Norfolk & Western, Roanoke, Va.; third vice-president, E. R. Purchase, Boston & Albany, Springfield, Mass.; and secretary-treasurer, A. R. Davis, Central of Georgia, Macon, Ga.

The following were chosen members of the executive committee: C. A. Shaffer, Illinois Central, Chicago, (chairman), J. Martin, O. D. Kinsey, Arthur Williams, and Chas. Petran.

GHENT UNIVERSAL EXHIBITION.

Although the Ghent Exhibition covers a great expanse of ground, and is made up of an extraordinary number of handsome exhibits, mainly from France and Belgium, the novelties in any particular department cannot be called either numerous or very striking. One of the features (in fact, one might say, apart from the textiles, the leading feature) of the exhibition is the rolling stock shed, where a large number of engines, tenders, carriages and trucks of various sorts and dimensions are on view. They are almost entirely, however, from the machine shops of France and Belgium. For example, as a locomotive or car builder Germany does not figure at all; no more does Italy; and British rolling stock builders, true to their traditions in this respect, take no part in the exhibition. America likewise is unrepresented. In this shed there are some interesting features present, the leading present-day one of which is that of the Usines Metallurgiques du Hainaut, who show a magnificent state railway locomotive measuring 57.4' between the axles, the front bogie having a 2.36" side play. This feature assumes greater importance today from the fact that on one of the Italian electrical railways a motor car is now running with trains at high speed on bogies that have this side play, negotiating curves without any danger. The experiment is said to have proved a complete success and derives its immediate interest from the claim that is made that it is the first occasion on which such action has been applied with high speed.

Other locomotives and the like in this shed are striking because of their workmanship, their weight and apparent gen-



Locomotive Superheater Corporation Exhibit at the Ghent Exhibition.

eral efficiency, rather than on account of any novelty that might be expected to appear in an exhibition.

A last word in connection with this shed may be said on behalf of a fashion that is now becoming very prevalent and threatens wooden tank cars with extermination; namely, the enameled steel tank car for the carriage of alcoholic liquors and the like. Americans are already well acquainted with the substitution of the metallic for the wooden tub for stationary uses, and also for transit. The car referred to is made by the Compagnie de Wagons Reservoirs of Paris, and represents a total weight of 18 tons. It is probably as ambitious a thing in the way of railway metallic tankers for human drinks as has been put on rails in Europe.

The most interesting, perhaps, from the technical point of view as a locomotive novelty is the exhibition made by the Locomotive Superheater Corporation, Ltd., of London, on the stand of the Great Central Railway Company in the British section. The feature of the exhibit as an exhibit is that the superheater and retarder in most of its details, as can be seen from the accompanying illustration, stands exposed for inspection by the visitor; and in order to inspect the boiler fitted with its apparatus a flight of steps is provided so that the same may be done comfortably and as thoroughly as possible under the circumstances. But for better comprehension and inspection the apparatus is exposed in section and uncovered, more particularly to show that the pipes can be, when desired, detached from it one by one without interfering with the other pipes; an advantage, of course, which requires no recommendation, but ought to be mentioned.

This superheater is the invention of the chief mechanical engineer of the Great Central Railway, John G. Robinson. It has a header or steam collector with transverse compartments and removable front cover plate for header with longitudinal compartments and removable top covers. It is not necessary to recapitulate the advantages that are claimed for this superheater, excepting that comprehensively they include simplicity, durability, maximum of efficiency and cheap installation and maintenance. An advantage in the construction is the elimination of flanged or special joints for connecting the elements to the header, the Robinson pipes being expanded directly into the header.

It is claimed that the superheater will attain as much superheat as that of any high temperature locomotive smoke tube superheater under equal conditions. The superheated and saturated steam compartments are open at the front of the header to permit of internal examination, and for the introduction of tube expanders into the ends of the superheating pipes which are easily, as stated above, disconnected from the header by using appropriate tools. These superheating pipes or elements, whilst being readily disconnected from the header without sustaining any damage, can be re-expanded into the header. A saving in coal consumption of 25 per cent, water 30 per cent and boiler repairs 20 per cent is claimed for this apparatus, with an increased hauling capacity compared with similar engines using saturated steam and with a boiler pressure of 20 pounds per square inch greater than those engines that use superheated steam at an average working temperature of 650 degrees F.

The list of countries using this superheater extends over the United Kingdom, to South America, Egypt, India, etc. The draught retarder or mechanical damper serves to obviate overheating of the elements when steam is shut off at the regulator. It consists of a number of small steam nozzles in the smoke box, one nozzle entering into the smoke box end of each large superheater smoke tube. They are connected to the pipe that feeds the blower so that the steam from each nozzle will just neutralize the forward draught caused by the blower when it is turned down. Thus a mechanical damper inside the smoke box, with all its troubles, is rendered unnecessary, and the retarder possesses numerous other advantages, such as elimination of moving parts inside the smoke box, regulation of the superheat, keeping the smoke tubes and elements clear of soot, and reduction of weight.

History of Passenger Car Heating.

By Calvin S. Parker, Asst. Sales Mgr., Parker Car Heating Co., London, Ontario.

The ventilation and heating of passenger cars is a subject upon which has been spent a great deal of time and energy not only by individuals, but by the representative bodies of the various railroad organizations. For some time but little headway was made towards improving the condition and about the only result gained was, if I might use the word, a "re-hash" of the already well known results produced by such systems as were then in use.

This state of affairs is now generally believed to have been owing to the fact that the heating devices then in use were in a very crude state of development and remained so until a comparatively recent date. However, as we are all well aware, the construction of practically all heating equipments and the operation thereof have been materially changed.

It will not be necessary to go back to the days when the crude method of having a stove in either end of the car was the only means used for warming passenger cars, but shall proceed directly to a consideration of the more modern method of heating by means of a system of water circulation.

The method of warming passenger cars by circulating hot water through the pipes placed around the car was first introduced, I believe, by Mr. Wm. C. Baker, of New York City, in the year 1866. The first of these heaters were installed, as near as I have been able to learn, on the New York, New Haven & Hartford R. R., and after a very hard and up-hill battle he was successful in selling a number of his "Baker Heaters," which were quite properly considered a wonderful improvement over the former method. In describing this system it will be unnecessary to say more than that it consists of a number of lines of pipe, usually 1¼ inch, placed along the truss plank on either side of the car, a portion of this pipe called a coil is placed inside the heater and having a suitable expansion chamber placed above the stove in the deck of the car. These pipes were filled with water and when fire was lighted in the stove the heat therefrom coming in direct contact with the pipes of the coil heated the water therein, causing it to rise to the expansion chamber and from there on it followed an unbroken course through the piping along both sides of the car, distributing its heat evenly to all parts of the car. The water was then returned back to the heater, there to be reheated and this same condition continued as long as there was a fire in the heater and sufficient water within the system to maintain "a chain of circulation."

The Baker heater system, outside of the crude method of a stove in either end of the car, was the only means used to warm passenger cars until about the year 1882 when the system of conveying the steam from the locomotive directly into the radiating pipes inside the car was introduced.

The first experiments in the United States with this system were made on the original New York Elevated R. R., and Mr. Wm. McWood, former superintendent of the car department, Grand Trunk Railway, was the "father" of steam heat in Canada as applied to passenger cars. The result of those experiments gave us what is now generally termed "direct steam." This system, has after years of practical demonstration, proven beyond question to be by far the most economical where it is possible to obtain at all times a supply of steam. Of course, where there is a possibility of the train being left without steam for any considerable length of time, for instance, where there is an engine failure on the road and it is impossible to obtain steam for several consecutive hours, it would then be absolutely essential to have some auxiliary means for maintaining a proper degree of heat in the car, and for cases such as these a system of water circulation has proven to be by far the most satisfactory.

It has been found, after years of practical use, that where a system of water circulation must be used, that it is more economical as well as good practice to heat and circulate the water within the Baker heater system by the application of steam from the locomotive.

This has been best accomplished by enclosing a portion of the radiating pipes in a suitable jacket or drum and conveying the steam either on the outside of the radiating pipe on the inside of the heating jacket or by running the steam pipe through the heating jacket which is filled with the circulation water, which, when heated, passes on up to the expansion chamber or drum and thereby causing a circulation of hot water passing through the radiating pipes entirely around the car, exactly the same as when a fire is lighted in the heater.

Of course a system of this kind has several disadvantages not found in direct steam systems; nevertheless, it has a number of desirable features which makes its use in some cases very essential.

In using steam for circulating the water, it is absolutely necessary that the condensation be gotten rid of as soon as it accumulates, with all styles of apparatus working on the gravity system, otherwise the heating would be impaired and ineffective and the apparatus very liable to freeze, particularly that portion of the system placed underneath the car.

Upon the introduction of the so-called automatic trap for releasing periodically the water of condensation, it has been found that such a device overcame the hand manipulation of the drip or blow-off valve, but it also wasted a considerable quantity of steam. If the trap were adjusted so as to not blow steam there was the liability of the trap freezing and if such became the case, as had frequently occurred, it was then necessary to stop the train and make outside application of heat to the frozen part by means of a steam hose, fusee, or by setting fire to a shovel full of oily waste and holding it against the frozen trap. The latter practice, which is quite common, is very dangerous, as there is a great liability of setting fire to the deafing between the floors of the car.

In using steam from the locomotive to heat the cars equipped with an indirect system it is the common practice to supply from 60 to 75 pounds of steam pressure for a ten-car train or less and it has been found that ordinarily a car will condense from 100 to 150 pounds of water per hour, which, on a ten-car train making a ten-hour run, represents a coal consumption of from 1,666 to 2,500 pounds for heating the train only.

It is to be understood, of course, that all systems of water circulation do not have the same condensing capacity, for instance,—a system having the steam jackets outside and underneath the car will condense a great deal more steam than a system having no part of the apparatus outside for the very apparent reason that with so much of the pipe, steam jackets, etc., outside, a great deal of heat is lost by exposure and it is also necessary to create a greater pressure within the heater pipes with this system in order to force the water through so many sags and around the many sharp turns and elbows necessary with a system of this kind.

By having the entire arrangement of radiating pipes, steam jackets and steam coils inside the car the liability of freezing is greatly reduced and the only point of difference in systems having this similar arrangement of piping is in the construction of the heater coil so far as the Baker heater system in itself is concerned.

The coils used in some systems are so constructed that after a fire has been used for some little time the ashes, clinkers, etc., accumulate around the coil, especially between the coil and the heater shell, greatly decreasing the heating surface and the result is that a great deal more fuel will necessarily be consumed in order to absorb the same amount of heat through this decreased heating surface.

The operation of the steam attachment of all heating systems working on the gravity system is practically the same, namely; the steam as admitted into the steam jacket or steam coil at the highest point and follows an unbroken circuit to the lowest point of the apparatus there one of the several styles of automatic traps allows the condensation to escape at the atmosphere. There has been in the past, and in fact there is being experienced at the present time considerable trouble with the traps freezing, of course, if the trap be adjusted so as to allow a little to escape with the condensation this will overcome the liability of the traps freezing in extremely cold weather, but this adjustment will cause the car to become intensely overheated when the weather moderates and will require a re-adjustment of the traps if it be desired to maintain a proper degree of heat in the cars.

Then again this trap may be adjusted to discharge condensation freely under a head of pressure of say 50 pounds and perhaps tomorrow this same car is put in a position in the train where it is being supplied with only 10 pounds steam pressure, it will be easily understood by those who understand the practical operation of any of the so-called "Automatic" traps that this adjustment which was correct for a 50 pound head of steam will not be the proper adjustment where the pressure is reduced to 10 pounds and will require another re-adjustment with a wrench, to make this trap work properly.

It is common practice with trainmen and others in the operation of the steam attachment of an indirect system of heating, to open wide the supply valve in heater room and so long as the trap is "blowing a little steam" with the condensation they give little or no attention to the apparatus during the run, and this practice usually results in an intensely over heated car. If the passengers complain of the overheated condition it is customary for the trainmen to open several or all of the ventilators in the deck of the car in an attempt to lower the temperature and when the car has cooled off below what is considered the average temperature the trainmen then close the ventilators allowing the temperature to rise and when the car becomes uncomfortably warm again the ventilators are opened, so that this condition of affairs continued during the entire run. While the heating apparatus in itself is "automatic" in so far that it requires very little attention during the run it is absolutely necessary to control the temperature of the car, and whether this is done properly or not depends upon the varying judgment of trainmen to what is in their opinion the correct amount of ventilation for the different classes of cars.

To those of us who have provided the necessary fuel for heating our homes, we would not, I am sure, consider it good practice nor would we be altogether pleased to learn that it was the common practice when the house became too warm to open wide the doors and windows, but naturally it would be expected that we should check the furnace or heater to reduce the heat and save the fuel. The question then arises why is this not done with the heating apparatus in passenger cars? As we are all well aware it has been claimed that when a car becomes too warm with a system of water circulation having its steam attachment working on the gravity system, the proper method of operation is to close the supply valve in heater room, thereby cutting off the admission of steam. This practice from a theoretical standpoint is quite proper, but in the practical operation of such a system this is very seldom, if ever done, for the very apparent reason that if all the condensation were not blown out of the steam jackets or steam coils and it drained to the traps in a very cool condition there is always a liability of freezing. Then again if the supply valve is not absolutely tight, as is very frequently the case, the small amount of steam thus admitted quickly condenses and reaches the trap in a very cool condition and this is another of the causes for the trap freezing. When the trap has become frozen from any one of the several causes, it is absolutely necessary, owing to the construction of the apparatus working on the gravity system, to stop the train and make the outside application of heat to the frozen part by means of a steam hose, torch, fusee or shovel full of burning waste. This practice, which is the only available means with a system of this kind, is frequently the direct cause of serious delays as well as considerable expense when repairs are made necessary.

The amount of steam being used and the drain on the locomotive is practically the same in moderate weather as in extremely cold weather. In extreme weather almost all the heat developed is needed to maintain a comfortable degree of heat in the car and it is well known that but a few of the ventilators are opened and which admit of an abundant supply of fresh air to keep the atmosphere inside the car sweet and pure; while in milder weather there is being supplied the same head of steam from the locomotive and the adjustment of the automatic traps is the same so that it is the common practice to open nearly all of the ventilators in the car in an attempt to control the temperature. It will be readily understood that there is being supplied and wasted a great deal more heat than is necessary to properly warm the car. After making extensive inquiries and having had considerable practical experience along this line, I have found that there is more trouble with cars freezing in moderate weather than in extremely cold weather. Of course it must be admitted that considerable portion of the trouble with heating equipments is due to the experience of those whose duty it is to handle them, nevertheless it cannot be denied that any method of heating working on the gravity system will condense upon an average of 125 lbs. of water per car per hour, through the entire heating season while the system of indirect heating being placed upon the market by the company with which I am connected has shown after exhaustive tests in weather varying from freezing point down to 50 degrees below zero, will condense upon an average of but 80 lbs. of water per car, per hour. Furthermore, with this system means have been devised whereby a frozen steam trap, heating jacket transfer pipe or steam coil will be automatically thawed out while the train is in motion. The method of regulating the temperature of the cars with this system is such that it does not supply any predetermined quantity of steam to any particular car in the train, but each car is supplied with just sufficient steam to maintain equal pressure throughout every car in the train and consequently an even temperature is produced automatically.

Another important and very desirable feature possible only with this system is that there is no blowing of steam from the trap to endanger the lives of the traveling public and employees. "Drips are expensive," therefore we close them up.

Direct Steam System.

What is generally termed direct steam systems of heating includes all systems wherein steam from the locomotive is conveyed by means of suitable train pipes and steam hose couplings and is used directly in the radiating pipes placed along the truss planks on either side of the car.

Under this heading are classed three separate and entirely different systems, namely; All styles of steam systems having a supply valve which admits the steam into the radiating pipes at the highest point, from there it is allowed to flow (by gravity) to the lowest point where the discharge of condensation is controlled by one of the several styles of "Automatic Traps."

The second system of this class included the several styles of "Vapor System" wherein the admission of steam into the radiating pipes controlled by the temperature of the escaping condensation.

The other system which comes under the heading of direct steam is the "Parker No-Drip System."

With this latter style of apparatus the steam is admitted into the radiating pipes through a regulator at practically their lowest point and it follows an unbroken circuit throughout the entire length of the radiating pipes to the combina-

tion discharge and auxiliary trap placed in proximity to the regulator valve. These traps and regulator valves are connected by means of a by-pass or cross-over. With this system the water of condensation instead of being discharged as soon as it accumulates is retained and kept heated by the inflowing steam which enters the apparatus as before stated at the lowest point, so that it will be obvious that the heating is affected by means of the combined steam and hot water therein.

There is usually a separate supply valve controlling the admission of steam into the radiating pipes on either side of the car with the improved systems of direct steam heating.

The operation of the first mentioned direct steam systems, namely; those having pressure in the radiating pipes and equipped with an "automatic" trap for the periodical discharge of condensation is precisely this—steam is turned into the train pipe after all steam hose have been properly coupled and it passes along through the train pipe in the first car until it reaches the branch which conveys the steam into the radiating pipes inside the car where part of the steam pressure goes into the piping in this car; the greater portion of the pressure is, however, forced on to the next car where the pressure is again reduced and so on until the steam has reached the rear of the last car in the train.

When steam first enters the radiating pipes in the car there is always an excessive amount of condensation, due chiefly

The following charts show the travel of steam in the radiating pipes of a 70-ft. standard passenger car with Regulator Valve in "Third," "Second" and "First" positions. The full black represents steam or parts of radiating pipes giving off heat.

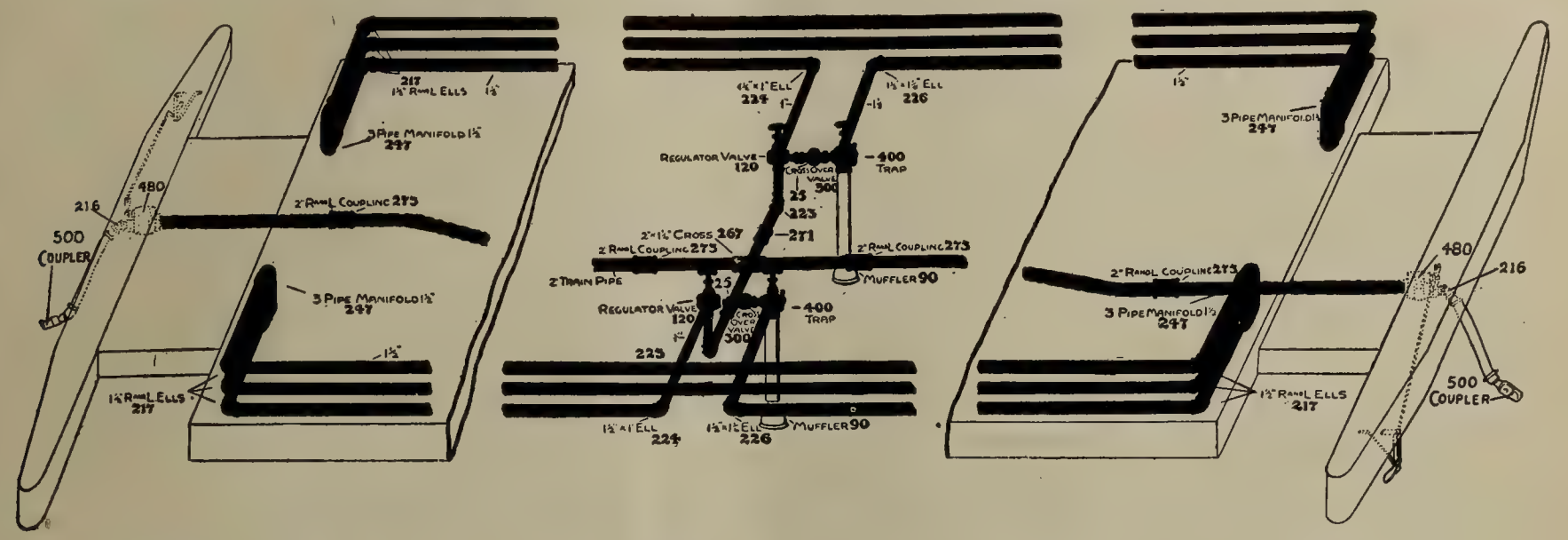


Fig. 1. Regulator Valves in Third or Full Open Position, Heating 100 Per Cent of the Radiating Surface.

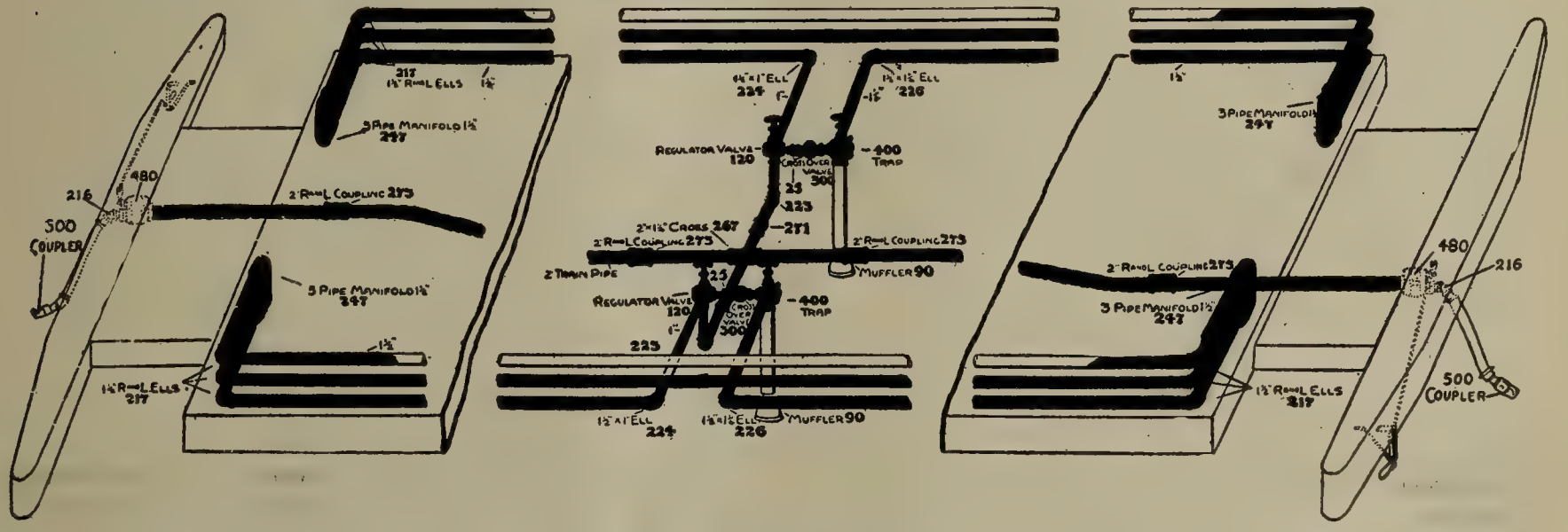


Fig. 2. Regulator Valves in Second or Half Open Position, Heating 75 Per Cent of the Total Radiating Surface.

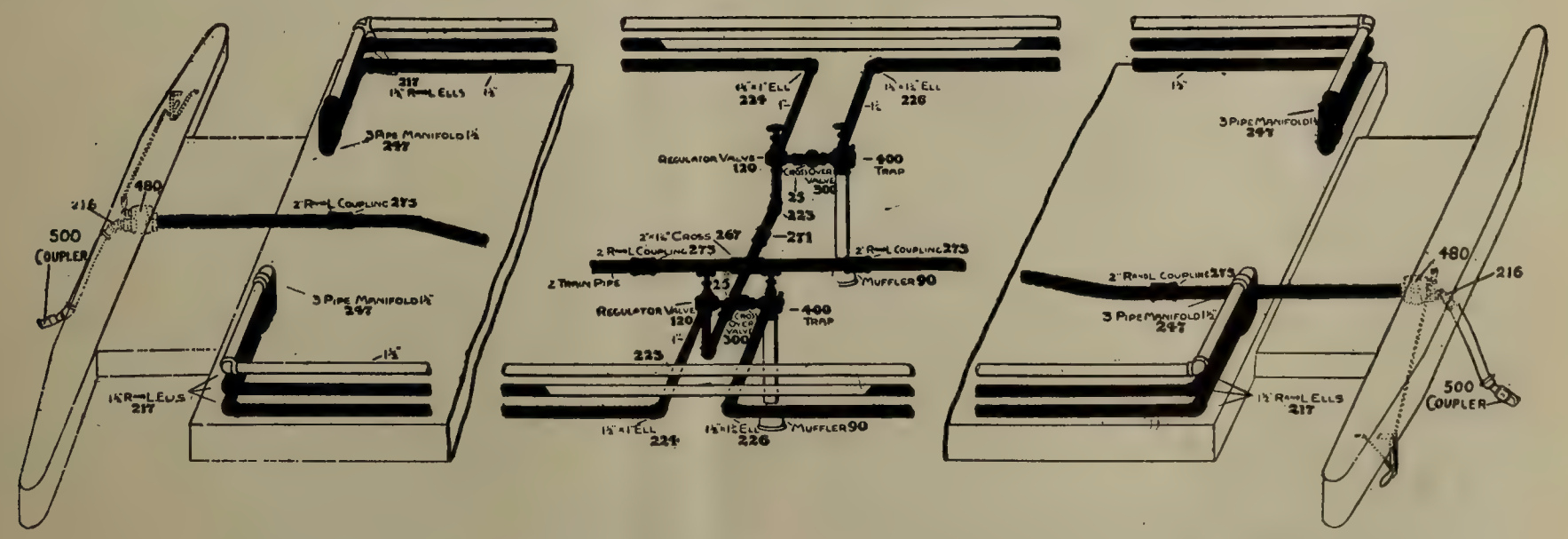


Fig. 3. Regulator Valves in First or Quarter Open Position, Heating 50 Per Cent of the Total Heating Surface.

to the cold condition of the pipes and to the low temperature of the cars. This condensation is forced along through the pipes by the pressure of steam behind it and as the automatic trap does not expand sufficiently to close the port until steam has blown upon the diaphragm, it will be readily understood that condensation is allowed to escape and as the trap cools the condensation is again discharged to the atmosphere, and when the temperature of this escaping condensation and steam is sufficient to cause the diaphragm to expand its maximum the port is again closed (provided, of course, that the adjusting device which holds the diaphragm be properly set). This continued expanding and contracting or heating and cooling of the diaphragm will continue as long as there is steam in the apparatus.

With a direct steam system there is not the same liability of the trap freezing as when applied to systems of water circulation, nevertheless, there is being experienced considerable trouble from this cause and the only means available for thawing it out are the same as when applied to indirect systems.

One of the chief disadvantages of the ordinary drip systems is that after the car has become heated considerable trouble has been experienced in regulating the temperature and the only really satisfactory means was to open and close the ventilators as the conditions required it.

Vapor or Atmospheric Pressure Systems of Heating.

The operation of this system is similar to the other drip system in so far that the steam is admitted into the radiating pipes at the highest point and following the laws of gravity it drains to the lowest pipe where the temperature of the escaping condensation regulates the admittance of steam into the radiating pipe.

With this system atmospheric pressure is maintained from the inlet valve through the radiating pipes to the diaphragm in the regulator. When steam is first turned into this apparatus it passes through the admission valve and into the radiating pipes and is then free to escape to the atmosphere first passing over the diaphragm or coil containing the expansive fluid which, when it has expanded its maximum, shuts off the supply of steam. When the diaphragm or coil has cooled, caused by the contact of cold air, the inlet valve is again opened admitting more steam so that it will be understood that there is a continual heating and cooling of the radiating pipes.

This system has an advantage in mild weather over the pressure system in so much that it does not produce that intense heat so noticeable and so very disagreeable, but in extremely cold weather the atmospheric pressure systems do not produce sufficient heat to maintain a proper degree of warmth in the cars without considerable waste of steam.

Besides this it has been found, after several years of operation, that in order to get the best results from these "Atmospheric" pressure or vapor systems it is necessary to install sufficient radiating surface to maintain a proper degree of heat in the car in extremely cold weather and then divide such radiating surface into "units" with separate mannaly operated valves for controlling the admission of steam into each unit. It is then necessary for the trainmen or porter to cut in or cut out the number of units which they consider are required to maintain the proper temperature in the car. Past experience has conclusively proven that it is not a satisfactory method to depend upon trainmen or porters to be continually cutting in or cutting out six or seven separate heating units to control the temperature of a passenger car. The result obtained by installing several complete separate sets of heating devices in one car does not justify the cost thereof, according to those who have been in a position to accurately check up the actual results obtainable thereby.

It will be noticed that the operation of all these systems depends primarily upon a diaphragm or other means for gaining expansion and contraction within the regulator and the successful operation thereof depends upon the adjustment of this diaphragm by means of the adjusting device placed upon all devices of this class.

The opening and closing of this so-called automatic traps and regulators is not governed solely by the amount of condensation backed up in the discharge pipe as is generally believed, but the opening is governed by the length of time it takes for the diaphragm to cool off, thereby opening the port, and the closing is governed by the amount of steam it takes to again expand the diaphragm sufficient to close the port, and this state of affairs continues indefinitely.

Parker No-Drip System.

The operation of this system is very similar to any of the other pressure systems in so far as admitting and releasing steam to the apparatus is concerned.

Steam is turned into the train pipe from the locomotive and passed through the train pipe to the branches which supply the radiating pipes on either side of the car. When steam is first admitted into the apparatus through the regulator valve it follows an unbroken circuit through the entire radiating pipes to the trap which is placed close to the regulator valve. Here the condensation first accumulating and the air is discharged, and the trap is then closed, which automatically opens the cross-over valve and the position of these valves remain the same throughout the entire run.

What actually takes place thereafter is this—when the entire radiating pipes are filled with steam the regulator valve is forced to seat and will positively not admit any more steam until the pressure in the radiating pipes is reduced (due to condensation) when it will allow just sufficient steam to enter the apparatus to again equalize the pressure.

It will be understood that by this method of regulation the pressure throughout the entire train is equalized; its operation is very similar to the working of the air brake system. So it can be readily seen that by entirely closing the traps and by this method of regulation a much lower initial or train pipe pressure can be carried.

The question quite naturally arises, "How long will it take then to fill the entire radiating pipes with condensation so as to retard the heating and what is done to relieve this condition of affairs?"

It can be stated after several years of continued use in all kinds of regular service that trains equipped with this system have been run over divisions varying from 100 to 300 miles without once releasing any of the condensation.

If the radiating pipes with this system become so full of water that the heating is decreased all that is necessary is to release just sufficient water to allow for expansion and the heating may be quickly established again. With the latest design of this apparatus this condition is taken care of automatically.

The initial or train pipe pressure required with this system is about 3 pound pressure for each car in the train, or about 30 pounds pressure for a ten car train and about 15 pound pressure for a five car train, while any method of heating working on the gravity system will require from 60 to 75 pounds steam pressure for ten car train and for a five car train or less it is the common practice to supply a minimum pressure of 40 pounds.

With such a great reduction in the steam pressure it will be seen that a great saving is effected in the wear and tear on steam hose which is today where the high pressure system is used, one of the largest items charged to "maintenance account."

The saving in coal consumption, and finally in dollars and cents with the "No-Drip" system is shown in the following comparison of figures based upon numerous tests made by roads in various parts of the United States and Canada during the heating seasons of 1910-11 and 1911-12:

Average Condensation in Pounds.

70 Foot Standard Coach.

	Per Hour.	Per Day.	Per Month.	Per Heating Season (7 mos.)
Drip Systems	125	2,500	75,000	525,000
Parker System	83	1,666	49,980	349,860
Average Saving with Parker System	42	834	25,020	175,140

Average Coal Consumption in Pounds.

6.0 pounds of water evaporated per pound of coal.

	Per Hour.	Per Day.	Per Month.	Per Heating Season (7 mos.)
Drip Systems	20.8	416	12,480	87,360
Parker System	13.8	276	8,280	57,960
Average Saving with Parker System	7.0	140	4,200	29,400

Average Cost and Saving in Dollars and Cents per Car.

Price of Coal based upon $2.50 per ton when in the fire box.

	Per Hour.	Per Day.	Per Month.	Per Heating Season (7 mos.)
Drip Systems	2.6	52	15.60	109.20
Parker System	1.7	34	10.35	72.45
Average Saving with Parker System	.9	18c	$5.25	$36.75

The present perfected heating equipment now supplied with the Parker "No-Drip" system is the evolution of an invention of a passenger conductor in actual service and points well to the established truth that the world depends for its really useful inventions upon the practical workings of the minds of men whose daily activity brings them in contact with service requirements and what more logical sequence in train heating theories than a practical conductor whose intelligent grasp of the problem best qualifies him to evolve a method calculated to readily negotiate all of the service conditions since his practical eye and mind enables him to test to final analysis each applied suggestion.

By Jas. F. McElroy, Cons. Engr., Consolidated Car Htg. Co.

The first train of cars used in this country for carrying passengers was run between Albany and Schenectady in the year 1831. I believe that no means of heating these cars was provided. As railroads came into more general use an attempt was made to heat the cars in cold weather. Generally, such fuel as was employed for generating steam on the locomotive was also used for the purpose of heating the cars.

In 1847 a long box stove made of heavy cast iron was used for car heating and this stove used the same length and size of wood as was used in the locomotive. The front door, located at one end of the stove, was hinged on the side and swung over the hearth which projected perhaps a foot beyond the stove. A piece of iron hinged to the hearth was used to swing up against the door and hold it in closed position. The stove was a crude affair which did not attempt to distribute the heat under the seats but was used, one in each end of the car. In other parts of the country coal stoves were employed where coal as a fuel was available.

Later a decided improvement was made in the method of heating by supplying fresh air in conjunction with the heating appliances of the car. The Spear stove was a good example of this method of heating. Air was taken from the outside of the car above the roof and carried down through the stove where it was heated and then discharged into horizontal ducts placed along the truss plank under the seats. The air thus heated was discharged at a comfortable temperature under each seat in all parts of the car. In some respects this arrangement was ideal in furnishing pure air warmed by the stove and distributing the pure air to all parts of the car. It was, however, liable to one objection, namely, that fire was carried in the car and this made it a source of danger.

In 1868 William C. Baker introduced a method of heating which in many respects was the most notable of all of the improvements in heating apparatus up to this time. The Baker heater was a high pressure hot water circulating system. The heater was placed in one corner of the car. It contained a coil of pipe, the upper end of which was connected by means of a vertical pipe to an expansion drum generally placed on the outside and on top of the car. A downflow pipe was connected to this same expansion drum and this pipe led down to the truss plank where it extended to the opposite end of the car and back to the center, then across to the opposite side of the car where it made an excursion to and fro on the truss plank. This pipe then led back and connected to the coil in the lower end of the heater. Sometimes one course of pipe was bent in the form of loops under the seats. The piping was then filled with water up to about the middle point of the expansion drum. When a fire was built in the heater a sort of intermittent or pulsating motion of the water was set up so that the heated water was carried through the pipe to all parts of the car.

The cause of circulation of water in this system was due to the formation of steam bubbles in the heater coil by the fire in the stove. The steam bubbles formed in this coil forced part of the water out of the riser pipe and the displacement of water thus effected gave the downflow pipe a preponderance in weight which caused the water to move forward. In this respect the Baker apparatus circulated by means very different from means employed in ordinary house heating apparatus.

In hot water house heating apparatus circulation is caused by the difference in weight in the rising and falling columns of water caused by difference of temperature. It operates in this manner because the radiators are higher than the source of heat which gives the hot water a chance to rise in passing from the heater to the radiator.

In the Baker system, however, the radiating pipes were lower than the heater and consequently there was no tendency to force circulation simply by difference of temperature of water alone. Heat sufficient to form steam bubbles in the riser pipe was necessary to cause effective circulation.

The Baker heater was used very extensively on the railroads in this country and in many respects was a very satisfactory method of heating. It was, however, liable to freeze up if the fire was neglected in cold weather and explosions sometimes occurred by the freezing of cross-over pipes which blocked circulation when the action of fire would then be to localize the heat generating a steam pressure which was liable to cause an explosion.

All of the apparatus which I have mentioned so far and which was used extensively up to 1887 involved the use of fire on the car in stoves or heaters with entirely inadequate protection against the escape of coals in case of railroad accident. It is true that Baker, for example, put iron screens across the openings of the smoke pipe and used perforated plates for the doors through which coal was fed into the stove and with perforated steel plates through which the ventilation into the ash pit took place. However, openings sufficiently large and free to permit the flow of air to the heater or to permit of the escape of smoke when these openings were partially clogged with ashes and soot were considered dangerous in case of accident to the car. It was also considered impractical to make a door to the heater which would at the same time be always closed and securely held in case of accident. The use of this apparatus, therefore, was considered to involve considerable danger in case of accident to the train.

Prior to 1887 several attempts had been made with more or less success to use steam for the purpose of heating trains of cars. This steam was taken from the locomotive and carried through the train and supplied pipes in the cars with steam; a suitable coupling device being employed between cars for connecting the steam pipes.

On account of several railroad accidents in 1886 and 1887 in which trains were set on fire by coal burning stoves, the public mind was directed to the necessity of getting rid of such stoves or heaters in cars.

A railroad wreck near White River Junction on the Central Vermont Railroad in 1887 in which many lives were lost by the burning of the cars ignited by stoves was especially instrumental in arousing public sentiment against the evils of the coal burning stoves in cars.

Since that time practically all cars in the United States have been changed so that these cars are heated with steam taken from the locomotive. The commingler and drum systems of heating, by means of which steam from the locomotive was employed for maintaining heat in the Baker heater or other hot water systems were devised. This enabled cars already equipped with the Baker heating system to be operated by means of steam from the locomotive and, at the same time, to maintain the Baker heater so that in case of failure of steam supply a fire could be built and the car kept warm.

This method of heating proved very satisfactory, except that it had one drawback, in that it made it necessary that cars should be kept warm at all times in cold weather to prevent freezing of water. This was often inconvenient when trains were laid off at the end of runs and when cars were put out of service.

What is known as the "Direct Steam" system was indicated in patents that were issued at an early day, although the method employing steam as shown in the early patents, was not thoroughly practical. Improvements had been made in the method of applying steam directly for heating the pipes in cars so that in 1886-87 trains were in operation which gave in many respects satisfactory results. The difficulties arising from the sags in the train line where water of condensation was liable to collect and freeze and difficulties from the lack of proper control over the temperature of the radiating pipes and of getting rid of the water collecting in the radiating pipes in the car have been pretty satisfactorily overcome, so that but little trouble is now experienced with railway trains from these sources. The steam couplers now used are nearly all of the Sewall type and give satisfactory service.

Several systems of heating have been used, such as the pressure system, the vacuum system, and the vapor system; each system having its own advocates and perhaps having points of advantage not possessed by other systems.

The pressure system will operate and give sufficient heat with a small amount of piping in the car.

The vacuum system requires a very large amount of heating surface and also requires means for maintaining a vacuum in the pipes. This system is not much used at this time.

The vapor system of heating maintains a very low pressure in the pipes and requires an increased amount of radiating pipes over that required for the pressure system. It practically maintains the piping at a uniform temperature of about 212°.

Ventilation.

A wide difference of opinion exists as to the necessity of ventilating cars. This difference is not as to whether ventilation is necessary, which all admit, but arises from uncertainty as to the amount of ventilation secured in an ordinary car operated at high speed with ordinary car ventilators and with a very large amount of openings around the doors and windows. Some people maintain that altogether too much ventilation is thus secured and consequently they proceed to reduce the amount of air entering the car through openings by installing storm sash over all windows. These sash are made to fit tight so as to prevent air from blowing through. Thus they reduce to a minimum the amount of air passing into the cars while in operation. Reference is here made especially to roads operating in cold climates.

Other roads have adopted a view that the air entering the car around the windows, etc., is necessary for proper ventilation and hence they do not attempt to reduce this air supply by the use of special appliances all tending to make the car as close as possible.

At variance with the plans above outlined some of our railroads consider that it is necessary to supply cars with a very large amount of outside air and very properly introduce this air over the heating pipes so that it enters the car at least partially warm. This method of heating then becomes an indirect method and whilst it has worked out successfully there still remains, among people competent to judge, a question as to whether the supply of air to a car through the ventilating system and through other sources of air supply has not gone to excess and supplies an unnecessary amount of air.

There is no question but what cars over-ventilated may be, at times, very uncomfortable for passengers and that this source of discomfort is worthy of attention as the discomfort which arises from not having cars sufficiently ventilated.

A golden mean between the extreme views on the subject of ventilation will give as pure air to breathe as can be expected in a car which at times is drawn through a smoke laden atmosphere behind a soft coal burning locomotive. Excess ventilation does not improve the quality of the air under such circumstances.

TESTS OF SUPERHEATER LOCOMOTIVES.*

By C. H. Benjamin and L. E. Endsley,
Purdue University, Lafayette, Ind.

INTRODUCTION.

The work done by the authors of this paper, reported to the association in 1911, showed a comparison of locomotive performance under different degrees of superheated steam. The Schmidt superheater was the last one which was installed. The work this year is a continuation of that accomplished upon the Schmidt superheater and shows the increased power of the superheater locomotive over the ordinary locomotive when both are using the same amount of coal. Last year a brief statement of the progress of the work was made, but no definite results were given. It was stated at that time that plans were under way to get a larger set of cylinders for the Purdue locomotive. This, however, was not done, and so the report this year only gives the increased power produced by superheating with the same sized cylinder. The work as outlined for the use of larger cylinders remains yet to be carried out at a future time.

Equipment.—The locomotive known as Schenectady No. 2, for the saturated tests, and No. 3 for the superheated tests, was used in all the work. When used with saturated steam the locomotive was in normal condition. When the Schmidt superheater was installed the number of small 2-inch flues was reduced from 200 to 107, and 21 large 5-inch flues were installed. The original water-heating surface in Schenectady No. 2 was 1,322 square feet. The change in the flues made necessary by the installation of the Schmidt superheater reduced the water-heating surface to 1,080 square feet. The heating surface of the Schmidt superheater is 324 square feet, making a total water and superheating surface of 1,404 square feet for Schenectady No. 3 after it was equipped with the Schmidt superheater. The nominal dimensions of Schenectady No. 3 as used in the tests with the Schmidt superheater installed are as follows:

Type	4–4–0
Total weight (pounds), about	109,000
Weight on four drivers (pounds), about	61,000
Driving-axle journals:	
Diameter (inches)	7½
Length (inches)	8½
Drivers, diameter (inches)	68.99
Valves (type, Richardson balanced):	
Maximum travel (inches)	6
Outside lap (inches)	1⅛
Inside lap (inches)	0
Ports:	
Length (inches)	12
Width of steam port (inches)	1.5
Width of exhaust port (inches)	3
Total wheel base (feet)	23
Rigid wheel base (feet)	8.5
Cylinders:	
Diameter (inches)	16
Stroke (inches)	24
Boiler (style, extended wagon top):	
Diameter of front end (inches)	52
Number of 2-inch flues	107
Number of 5-inch flues	21
Length of flues (feet)	11.5
Heating surface in flues (square feet)	956.5
Heating surface in fire box (square feet)	123.5
Total water-heating surface (square feet)	1,080.0
Length of fire box (inches)	72.06
Width of fire boxes (inches)	34.25
Depth of fire box (inches)	79
Grate area (square feet)	17
Thickness of crown sheet (inches)	7/16
Thickness of tube sheet (inches)	9/16

*A paper before the American Railway Master Mechanics Association.

Number	Laboratory Symbol	Speed Miles per hour	Dry Coal per Sq. Ft. of Grate Surface per Hr.	Smoke Box Temperature Degrees F.	Equiv. Evaporation per Sq. Ft. Heating Surface per Hr. Pounds	Equiv. Evap. per pound of dry coal	Cut Off Per Cent of Stroke	M E P pounds per Sq. inch	Indicated Horse Power	Pounds of Steam per I.H.P. per Hour	Pounds Coal per I.H.P. Hour	Draw-Bar Pull Pounds	Draw-Bar Horse Power
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
1	30–2–200	30.0	55.0	673	6.96	3.82	14.19	37.88	268.9	27.01	3.48	2965	237.4
2	30–4–200	30.0		682	8.56		18.87	51.69	367.1	25.70		3847	307.4
3	30–6–200	30.0	98.0	708	11.12	8.63	26.75	68.90	489.2	24.91	3.40	5380	430.1
4	30–4–160	29.9	51.9	662	6.60	9.89	17.84	38.39	272.1	26.86	3.24	2655	211.9
5	30–6–160	30.0	68.9	707	8.75	9.87	25.67	54.08	383.9	25.28	3.05	3786	302.5
6	30–8–160	30.0		763	10.91		33.06	65.58	465.1	25.69		5130	410.9
7	30–4–120	30.0	35.4	608	4.70	10.32	17.62	24.09	171.0	30.63	3.52	1277	102.1
8	30–8–120	30.1	63.6	676	7.99	9.77	32.79	45.82	325.5	27.46	3.32	3369	269.5
9	30–14–120	29.9	130.7	835	13.99	8.38	56.25	72.56	514.0	30.31	4.28	6258	500.6

Table 1.

Thickness of side and back sheet (inches) 3/8
Diameter of stay bolts (inches) 1
Diameter of radial stays (inches) 1 1/8

The Schmidt superheater, as used in these experiments, has the following dimensions:

Outside diameter of superheater tube (inches) 1 3/8
Number of double return loops 21
Average length of the pipes in the double return loops (feet) .. 42.88
Total superheating surface, based on the outside surface of the tubes in square feet 324

Number	Laboratory Symbol	Equiv. Steam for Engine per Hour Feed Water at 60° F.	Equiv. Evap. per pound of Dry Coal E=11.305-.221 H	Dry Coal fired per Hr. Corr. by Equation	Dry Coal per Sq. Ft. Grate Surface per Hr. Pounds	Dry Coal per I.H.P. per Hr.	Equiv. Steam per I.H.P. per Hr.	Machine-Friction: Mean Effective Pressure	Machine-Friction: Indicated Horse-Power	Machine-Friction: Per Cent I.H.P.	Dynamometer Horse-Power	Draw-Bar Pull	Coal per Dyna Horse Power per Hr.	Equiv. Steam per Dyna Horse Power Per Hour
I	II	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII
1	30–2–200	8768	9839	891	52.4	3.31	32.60	6.5	46.1	17.1	222.8	2780	4.00	39.35
2	30–4–200	11354	9.408	1207	71.0	3.29	30.92	8.5	60.4	16.4	306.7	3830	3.93	37.02
3	30–6–200	14683	8.850	1659	97.6	3.39	30.00	9.3	66.0	13.5	423.2	5290	3.92	34.70
4	30–4–160	8785	9.836	893	52.5	3.28	32.28	8.5	60.4	22.2	211.7	2640	4.22	41.50
5	30–6–160	11663	9.355	1246	73.3	3.25	30.38	9.3	66.0	17.2	317.9	3970	3.92	36.69
6	30–8–160	14347	8.906	1611	94.8	3.46	30.85	8.4	59.6	12.8	405.4	5070	3.97	35.39
7	30–4–120	6269	10.257	611	35.9	3.57	36.69	8.5	60.4	35.4	110.6	1380	5.52	38.68
8	30–8–120	10683	9.519	1122	66.0	3.45	32.80	8.4	59.6	18.3	265.9	3320	4.22	40.18
9	30–14–120	18654	8.186	2278	134.0	4.43	36.29	3.0	21.3	4.1	492.7	6160	4.62	37.86

Table 2.

The fuel used in all the tests, both superheated and saturated, was Youghiogheny lump. Repeated analyses of this coal show it to have a very uniform heat value.

TESTS USING SATURATED STEAM.

The tests involving saturated steam, which were used in this report, were taken directly from Tables IV and V in the report of Dean W. F. M. Goss to the association in 1909. All the tests were run at a speed of 30 miles per hour, and steam pressures of 200, 160 and 120 pounds. The conditions of pressure and cut-off under which the tests were run are shown diagrammatically in Fig. 1. The cut-off is determined by the position of the reverse lever in notches. Each circle represents a test, and the number within the circle refers to the

Number	Laboratory Symbol	Speed Miles per Hour	Dry Coal per Sq. Ft. of Grate Surface per Hr. Lbs.	Smoke Box Temp. Degrees F.	Degrees Superheat F.	Equiv. Evap. per Sq. Ft. of Heating Surface per Hr. Pounds	Equiv. Evapor. per Lb. of dry Coal	Cut-Off Per Cent of Stroke	M E P pounds per Sq. in.	Indicated Horse-Power	Pounds of Steam per I.H.P. per Hr.	Pounds of Coal per I.H.P. per Hr.	Draw-Bar Pull	Draw-Bar Horse-Power
I	II	III	IV	V	Va	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
1	30–2–200	30.3	48.2	558	187.0	6.08	10.40	17.87	41.42	290.2	21.30	2.82	2808	226.9
2	30–4–200	30.1	62.1	622	222.0	7.79	10.38	31.35	61.47	438.1	17.88	2.41	4499	361.4
3	30–6–200	29.9	82.6	657	246.2	9.20	9.28	37.45	74.82	526.5	17.49	2.67	5702	452.8
4	30–9–200	30.0	127.3	714	298.5	12.42	8.06	49.54	97.34	696.4	18.64	3.11	7454	596.7
5	30–4–160	30.0	46.5	579	201.6	6.01	10.70	21.00	44.90	317.2	19.56	2.50	3282	261.2
6	30–6–160	30.0	59.2	609	226.3	7.30	10.20	30.00	55.30	394.0	18.77	2.55	4165	334.3
7	30–8–160	30.0	74.4	610	245.4	8.88	9.86	38.00	69.06	490.7	18.38	2.58	5293	423.2
8	30–9–160	29.6	92.7	627	270.3	9.65	8.78	44.53	77.59	544.4	18.67	2.90	5543	437.8
9	30–11–160	30.0	109.3	682	253.1	11.70	8.84	52.40	86.90	615.1	19.75	3.02	6664	532.6
10	30–12–160	28.9	124.2	842	244.3	12.30	8.18	56.82	93.41	643.5	20.09	3.28	7199	553.6
11	30–8–120	30.0	59.6	583	223.6	7.03	9.77	38.93	47.59	343.2	21.30	2.95	3845	308.8
12	30–10–120	30.0	65.0	584	243.9	8.24	9.74	44.13	53.37	419.7	20.14	2.64	4702	374.2
13	30–14–120	30.0	96.9	629	277.1	10.66	8.93	59.84	72.19	511.4	21.52	3.21	5856	469.7
14	30–15–120	31.2	103.3	685	305.1	11.68	9.34	60.48	74.04	548.8	21.87	3.20	5288	441.3
15	30–16–120	30.0	110.3	696	293.1	11.71	8.76	64.45	73.42	535.7	22.54	3.50	6137	491.0
16	30–18–120	29.9	121.7	726	280.0	12.95	8.79	73.08	77.79	590.6	24.50	3.76	6342	505.4

Table 3.

laboratory number by which the tests are identified. The results of the tests involving saturated steam are shown in Tables I and II.

The Performance of the Boiler.—In the 1909 report of Dean W. F. M. Goss, the relation between the equivalent evaporation per pound of dry coal and the equivalent evaporation per square foot of heating surface per hour for the locomotive using saturated steam is shown by the equation E = 11.305 — .221 H, in which E is the equivalent evaporation per pound of dry coal and H is the equivalent evaporation per square foot of heating surface per hour. This equation is assumed to represent the evaporative efficiency of the boiler when operated under saturated steam. In order to obtain the relation between the equivalent evaporation per pound of dry coal and the rate of firing, an equation was obtained in the following manner: Letting G equal the dry coal per square foot of grate surface per hour, 1,322 is the number of square feet of water-heating surface, 17 the number of square feet of grate surface, and H and E the same as above mentioned. Now, from the above values, the following equation is true:

Number	Laboratory Symbol	Equiv. Steam for Engine per Hour Feed Water at 60° F.	Equiv. Evap. per pound of Dry Coal E=11.305-.221 H	Dry Coal fired per Hr. Corr. by Equation	Dry Coal per Sq. Ft. Grate Surface per Hr. Pounds	Dry Coal per I.H.P. per Hr.	Equiv. Steam per I.H.P. per Hr.	Machine-Friction: Mean Effective Pressure	Machine-Friction: Indicated Horse-Power	Machine-Friction: Per Cent I.H.P.	Dynamometer Horse-Power	Draw-Bar Pull	Coal per Dyna Horse Power per Hr.	Equiv. Steam per Dyna Horse Power Per Hour
I	II	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII
1	30–2–200	8397	10.50	800	47.1	2.76	28.94	6.5	46.5	16.00	243.7	3017	3.28	34.46
2	30–4–200	10737	9.96	1078	63.4	2.46	24.50	8.5	60.2	13.70	377.9	4706	2.85	28.42
3	30–6–200	12817	9.51	1348	79.4	2.55	24.25	9.3	65.2	12.30	463.3	5840	2.91	27.67
4	30–9–200	17435	8.48	2056	120.9	2.95	25.04	7.7	54.7	7.90	641.7	8018	3.20	27.17
5	30–4–160	8349	10.53	793	46.6	2.50	26.32	6.5	45.7	14.40	271.3	3415	2.92	30.75
6	30–6–160	10060	10.11	993	58.5	2.53	26.91	8.5	60.2	15.30	353.8	4162	2.98	30.14
7	30–8–160	12372	9.61	1287	75.7	2.62	25.22	9.3	65.7	13.40	425.0	5320	3.03	29.12
8	30–9–160	13835	9.30	1488	87.5	2.73	25.41	7.7	54.0	9.90	490.4	6217	3.03	28.21
9	30–11–160	16424	8.71	1886	110.9	3.07	26.70	6.0	42.6	6.90	572.5	7161	3.29	28.69
10	30–12–160	17272	8.52	2027	119.2	3.15	26.84	5.0	34.2	5.30	609.3	7917	3.33	28.35
11	30–8–120	9932	10.20	974	57.3	2.84	28.94	8.4	59.5	17.30	283.6	3533	3.43	35.02
12	30–10–120	11456	9.81	1168	68.7	2.78	27.30	6.9	48.5	11.70	371.2	4666	3.15	30.80
13	30–14–120	15183	8.98	1691	99.5	3.31	29.69	3.0	21.2	4.20	490.2	6112	3.45	30.98
14	30–15–120	16399	8.72	1881	110.6	3.43	29.88	3.0	22.2	4.00	526.6	6334	3.57	31.14
15	30–16–120	16436	8.71	1887	111.0	3.52	30.68	3.0	21.3	4.00	514.4	6311	3.67	31.95
16	30–18–120	18186	8.31	2188	128.7	3.97	33.03	3.0	21.2	3.90	529.4	8123	4.13	34.35

Table 4.

$$1{,}322\ H = 17\ E\ G, \text{ or } H = \frac{17\ E\ G}{1{,}322}$$

Substituting this value of H in the equation E = 11.305 — .221 H, we obtain the equation $E = \frac{3{,}978}{G + 351.9}$

This equation gives the relation between equivalent evaporation per pound of dry coal and the dry coal per square foot of grate surface per hour when using saturated steam. The graphical representation of this equation is shown in Fig. 2.

Performance of Original Locomotive, Assuming Irregularities to Have Been Eliminated.—Table II shows the performance of the loco-

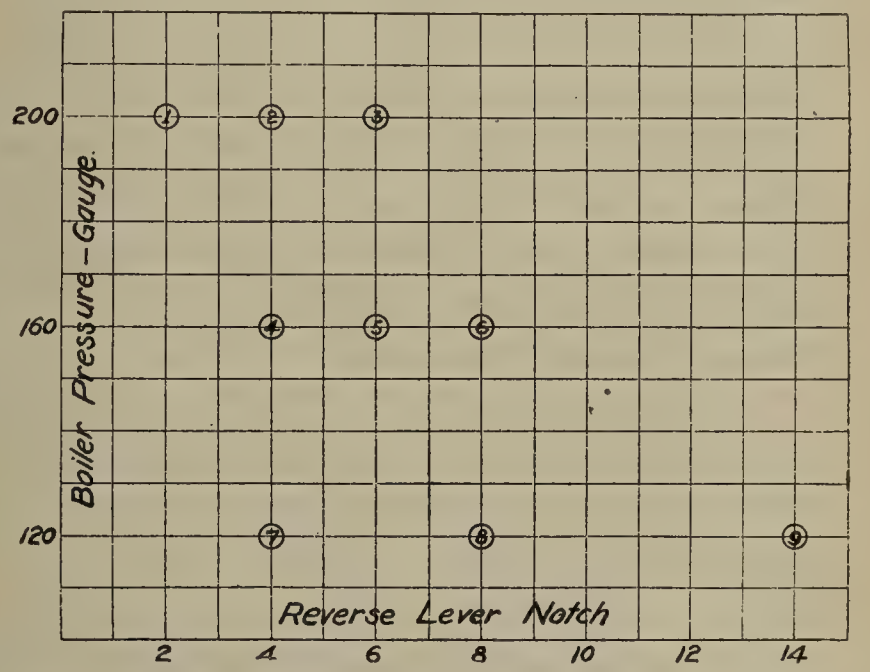


Fig. 1. Conditions of Pressure and Cut-off for the Engine Using Saturated Steam.

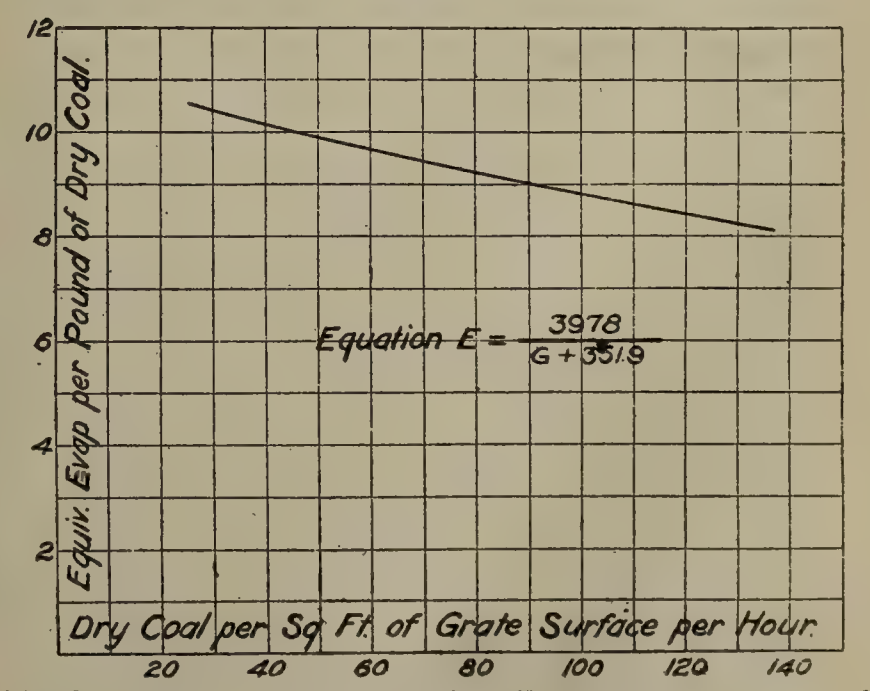


Fig. 2. Relation Between Equivalent Evaporation Per Pound of Dry Coal and Dry Coal Per Square Foot of Grate Surface Per Hour for the Engine Using Saturated Steam.

motive, assuming irregularities due to boiler performance to have been eliminated. The results in this table were obtained as follows:

Column XV, which gives equivalent steam supplied to locomotive per hour with feed water at 60° F. equals pounds of steam supplied to locomotive per hour from original log multiplied by (B. t. u. taken

Dry Coal per Sq Ft of Grate Surface per Hour	Steam Pressure	Equiv Evap per Pound of Dry Coal		Equiv - Pounds of Steam per Hour		Cut-Off in Percent		Equiv Pounds of Steam per I.H.P per Hr		M.E.P Lbs per Sq In		Indicated Horse Power		Percent Increase in I.H.P
		Sat	Sup	Sat	Sup	Sat	Sup	Sat	Sup	Sat	Sup	Sat	Sup	
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
110	200	8.61	8.73	161007	163251	29.5	46.1	30.1	24.9	75.3	92.4	534.8	655.8	22.6
110	160	8.61	8.73	161007	163251	32.3	52.4	30.7	26.4	73.8	87.1	524.3	618.4	18.0
110	120	8.61	8.73	161007	163251	49.9	63.05	34.7	30.3	65.4	75.8	464.2	538.5	16.0
120	200	8.43	8.50	171972	173400	31.6	50.9	30.3	25.2	80.0	96.9	567.8	688.1	21.2
120	160	8.43	8.50	171972	173400	34.3	55.5	31.1	26.7	77.9	91.5	553.1	649.6	17.5
120	120	8.43	8.50	171972	173400	52.5	65.95	35.3	31.1	68.6	78.5	487.2	557.5	14.4
130	200	8.25	8.28	182325	182988	33.4	53.2	30.5	25.5	84.2	101.0	597.8	717.4	20.0
130	160	8.25	8.28	182325	182988	36.0	58.2	31.5	27.1	81.5	95.1	578.8	675.2	16.7
130	120	8.25	8.28	182325	182988	54.9	68.7	35.8	31.8	71.7	81.0	509.2	575.3	13.0

Table 5.

up by each pound of steam minus [60 minus feed-water temperature]) divided by 970.4 (latent heat of evaporation).

Column XVI, which gives the equivalent evaporation per pound of dry coal corrected by equation, was obtained by substituting the values in Column VI, Table I, for H in the question E = 11.305 — .221 H.

Column XVII, which gives dry coal fired per hour corrected by equation, equals Column XV divided by Column XVI.

Column XVIII, which gives dry coal per square foot of grate surface

Superheater Engine 120# Dry Coal Per Sq. Ft of Grate Surface per Hour

Steam Pressure	Cut-Off in Percent of Stroke	Equiv. Lbs of Steam per I.H.P per Hr	M.E.P Pounds per Sq. Inch	Cut-Off at Maximum Efficiency	Equiv. Lbs of Steam per I.H.P per Hr at Maximum Efficiency	M.E.P at Maximum Efficiency	Percent Increase in I.H.P	Diam of Cyl in Inches to give Maximum Efficiency
I	II	III	IV	V	VI	VII	VIII	IX
200	50.9	25.2	96.9	35.0	24.2	70.0	3.97	18.82
160	55.5	26.7	91.5	37.0	25.2	66.7	5.62	18.73
120	65.95	31.1	78.5	44.0	27.3	58.0	12.22	18.62

Table 6.

per hour, equals Column XVII divided by 17 (the number of square feet of grate surface).

Column XIX, which gives dry coal per indicated horsepower per hour, equals Column XVII divided by Column X in Table I.

Column XX, which gives the equivalent steam per indicated horsepower per hour, equals Column XV divided by Column X in Table I.

Column XXI, which gives the machine friction in terms of mean effective pressure, was taken from Fig. 13, page 158, of the 1909 report of Dean Goss.

Column XXII, which gives the machine friction in horsepower, is obtained by using the value of M. E. P. of Column XXI and the speed in revolutions per minute of the individual test, together with the indicated horsepower constant of the locomotive.

Column XXIII, which gives the machine friction in per cent of indicated horsepower, equals Column XXII divided by Column X in Table I and multiplied by 100.

Column XXIV, which gives dynamometer horsepower, equals Column X in Table I minus Column XXII in Table II.

Column XXV, which gives the drawbar pull, equals Column XXIV divided by (.000547 multiplied by the revolutions per minutes), in which .000547 is the tractive horsepower constant of the locomotive.

Column XXVI, which gives the coal per dynamometer horsepower per hour, equals Column XVII divided by Column XXIV.

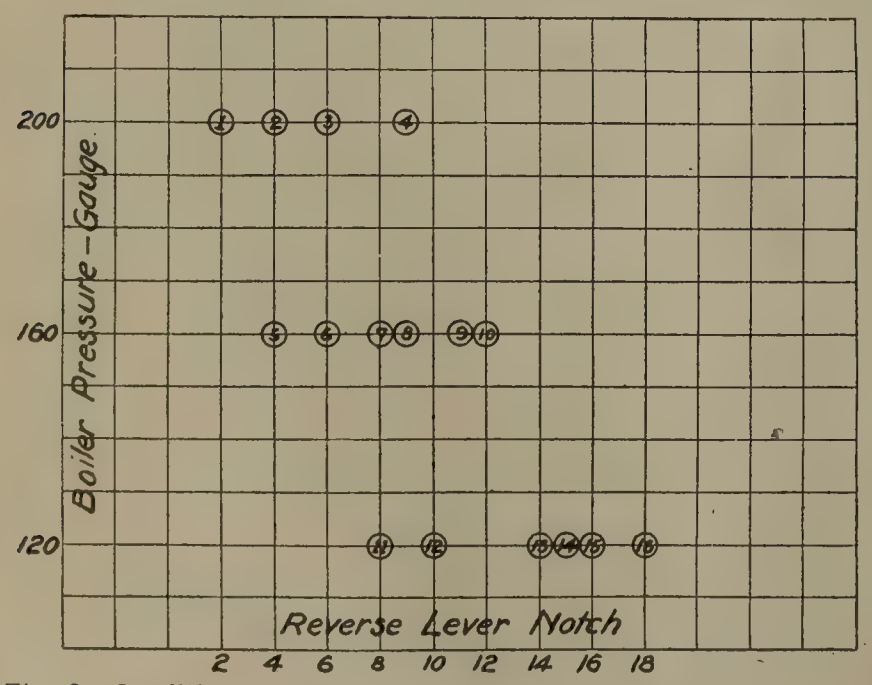


Fig. 3. Conditions of Pressure and Cut-off for the Engine Using Superheated Steam.

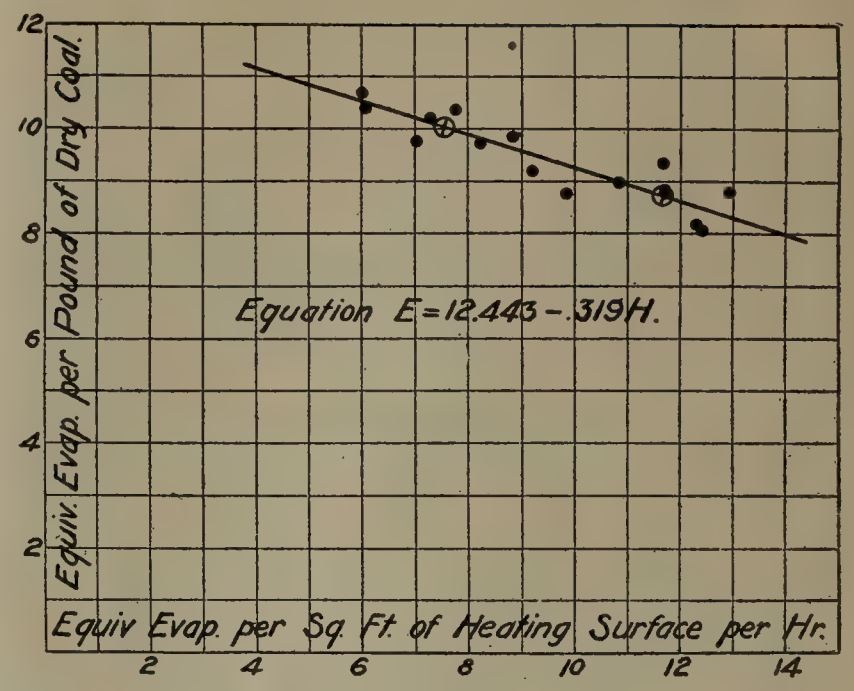


Fig. 4. Relation Between Equivalent Evaporation Per Pound of Dry Coal and Equivalent Evaporation Per Square Foot of Heating Surface Per Hour for Engine Using Superheated Steam.

Column XXVII, which gives the equivalent steam per dynamometer horsepower per hour, equals Column XV divided by Column XXIV.

TESTS USING SUPERHEATED STEAM.

The tests involving superheated steam, as run on Schenectady No. 3, were at a speed of 30 miles an hour, at the same pressures as were used on the original locomotive—that is, 200, 160 and 120 pounds. The conditions of pressure and cut-off under which the tests were run are shown diagrammatically in Fig. 3, in which the cut-off is determined by the position of the reverse lever notch. Each circle represents a test, and the number written in the circle represents the laboratory number by which the tests are identified. The results of tests under superheated steam are shown in Tables III and IV. It will be seen that the reverse lever was carried to a higher notch than with the saturated steam.

The Performance of the Boiler.—The equivalent evaporation per square foot of water and superheating surface per hour and the equivalent evaporation per pound of dry coal, Columns VI and VII in Table III, were plotted as shown in Fig. 4. There were sixteen different tests run under superheated steam, and, as shown, each point represents one test. The equation for the line as shown, which most nearly approximates all the points, is E = 12.443 — .319 H, where E is the equivalent evaporation per pound of dry coal and H is the equivalent evaporation per square foot of water and superheating surface per hour. The area of the heating surface is based upon the interior surface of the fire box and the exterior surface of the boiler and superheating tubes. This equation was derived from all tests at all pressures, and therefore fairly represents the average performance of the boiler at any pressure when operated under superheated steam. It is a noteworthy fact that this equation is practically the same as that obtained from the lower rates of firing reported to the association in 1911. The equation for the nine points as obtained that year

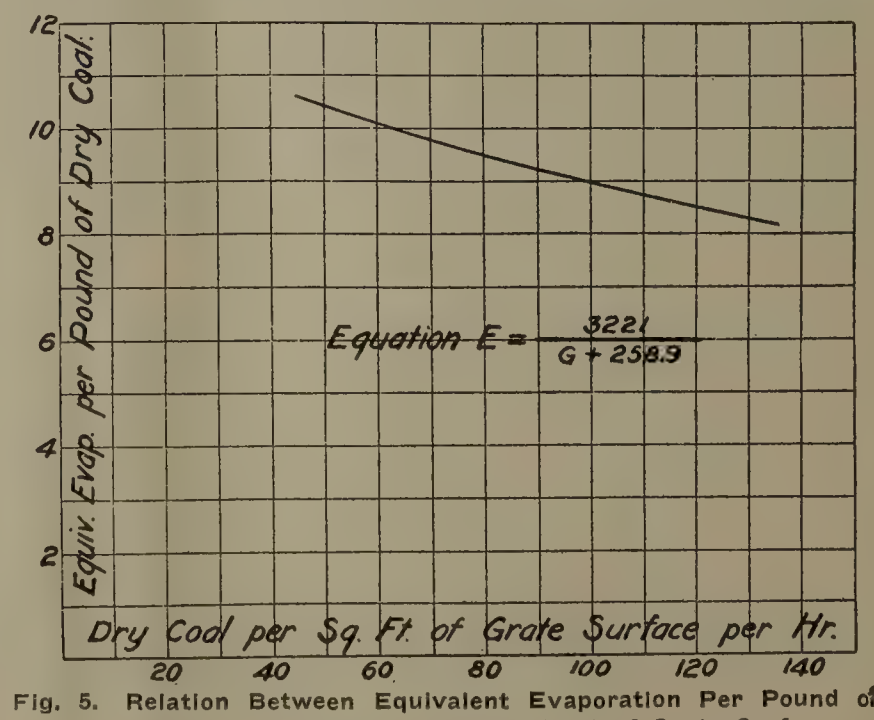


Fig. 5. Relation Between Equivalent Evaporation Per Pound of Dry Coal and Dry Coal Per Square Foot of Grate Surface Per Hour for Engine Using Superheated Steam.

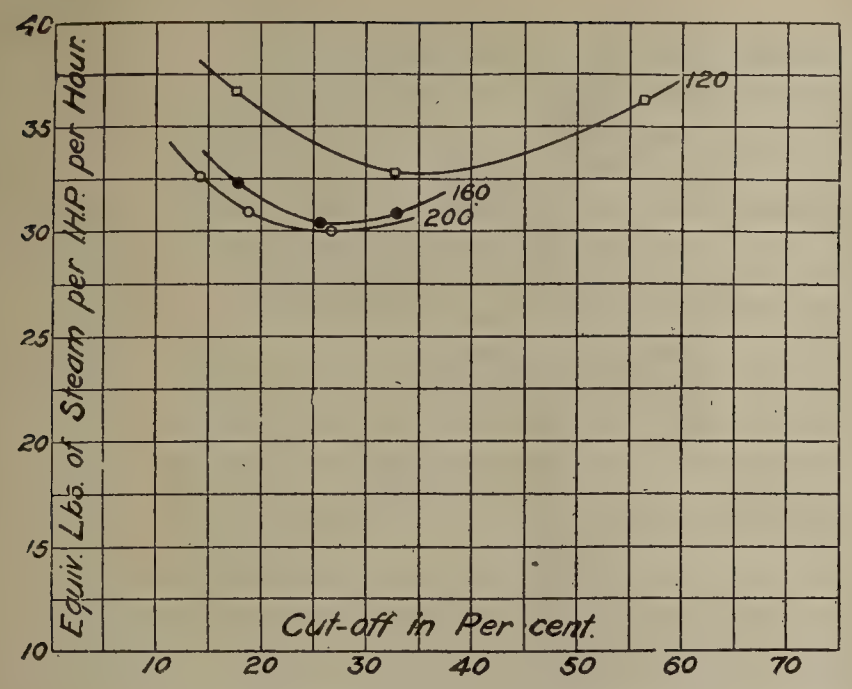


Fig. 6. Relation Between Equivalent Pounds of Steam Per I. H. P. Per Hour and Cut-off for the Engine Using Saturated Steam.

was E = 12.450 — .318 H. In the same manner as used in the original locomotive, G equals the dry coal per square foot of grate surface per hour, 1,404 the number of square feet of water and superheating surface, 17 the number of square feet of grate surface, and H and E the same as before mentioned, the following formula is true:

$$1{,}404\ H = 17\ E\ G, \text{ or } H = \frac{17\ E\ G}{1{,}404}$$

Substituting this value of H in the equation E = 12.443 — .319 H, we obtain the equation $E = \frac{3{,}221}{G + 258.9}$, which shows the relation between the equivalent evaporation per pound of dry coal and the dry coal per square foot of grate surface per hour when using superheated steam. The graphical representation of this equation is shown in Fig. 5.

Performance of the Superheater Locomotive, Assuming Irregularities to Have Been Eliminated.—Table IV shows the performance of the locomotive when using superheated steam, assuming irregularities to have been eliminated. The results in this table were obtained in exactly the same manner as those from the locomotive when using saturated steam as shown in Table II, and may be compared with them.

THE INCREASE OF POWER OF THE SUPERHEATER LOCOMOTIVE OVER THE ORIGINAL LOCOMOTIVE WHEN USING THE SAME AMOUNT OF COAL.

Having now obtained the values as shown in Tables II and IV for the two types of locomotives, the curves as shown in Figs. 6 to 9 were plotted. By the use of the equations of the curves in Figs. 2 and 5, the equivalent pounds of steam per pound of coal can be determined for any rate of firing of either locomotive. Also, from Figs. 6 and 7, the equivalent pounds of steam per I. H. P. per hour can be determined for any cut-off, and from the lines shown in Figs. 8 and 9 the mean effective pressure for any cut-off can be ascertained. Now, assuming that the curves as shown in these figures fairly represent the performance of each locomotive, it is possible to obtain the performance of each locomotive at the same rate of firing—that is, burning the same number of pounds of coal per square foot of grate area per hour. Table V shows this comparison of the two locomotives while burning 110, 120 and 130 pounds of coal per square foot of grate.

Column I of this table shows the rate of firing per square foot of grate per hour.

Column II gives the steam pressure, the comparisons being made at three pressures, namely, 200, 160 and 120.

Column III gives the equivalent evaporation per pound of dry coal for the original locomotive, and was obtained by substituting the values in Column I for G in the equation $E = \frac{3{,}978}{G + 351.9}$

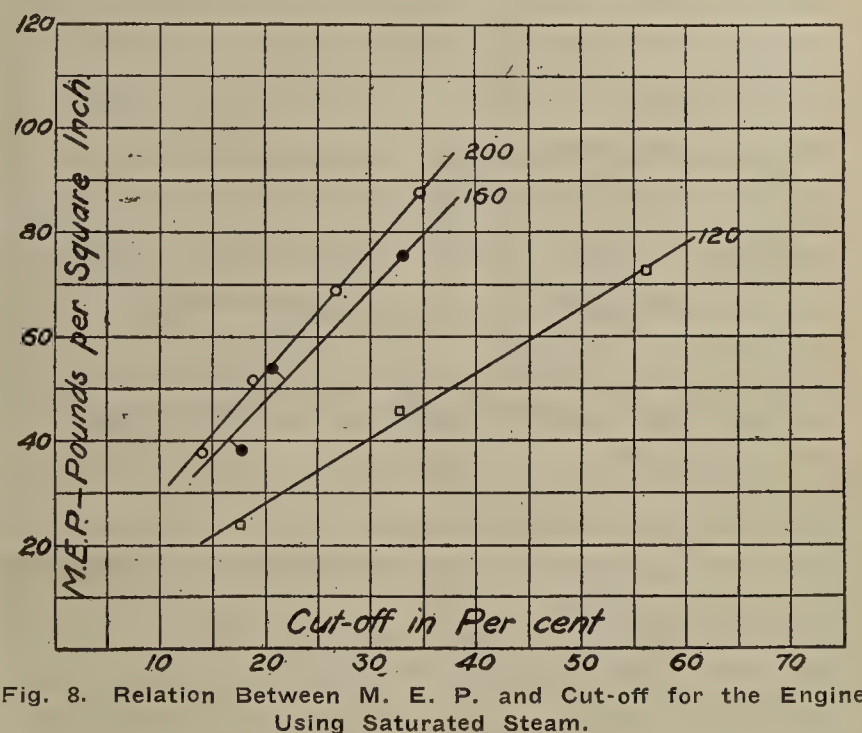


Fig. 8. Relation Between M. E. P. and Cut-off for the Engine Using Saturated Steam.

Column IV gives the equivalent evaporation per pound of dry coal for the superheater locomotive, and was obtained by substituting the values in Column I for G in the equation $E = \frac{3{,}221}{G + 258.9}$

Column V. gives the equivalent pounds of steam per hour for the ordinary locomotive, and was obtained by multiplying the values in Column I by those in Column III and then by 17.

Column VI gives the equivalent pounds of steam per hour for the superheater locomotive, and was obtained by multiplying the values in Column I by those in Column IV and then by the grate area, which is 17 square feet.

Columns VII and XIV were obtained in a "cut and try" method, which is shown by the following example: When using 110 pounds of coal per square foot of grate area under a steam pressure of 200 pounds we get at a 48 per cent cut-off;

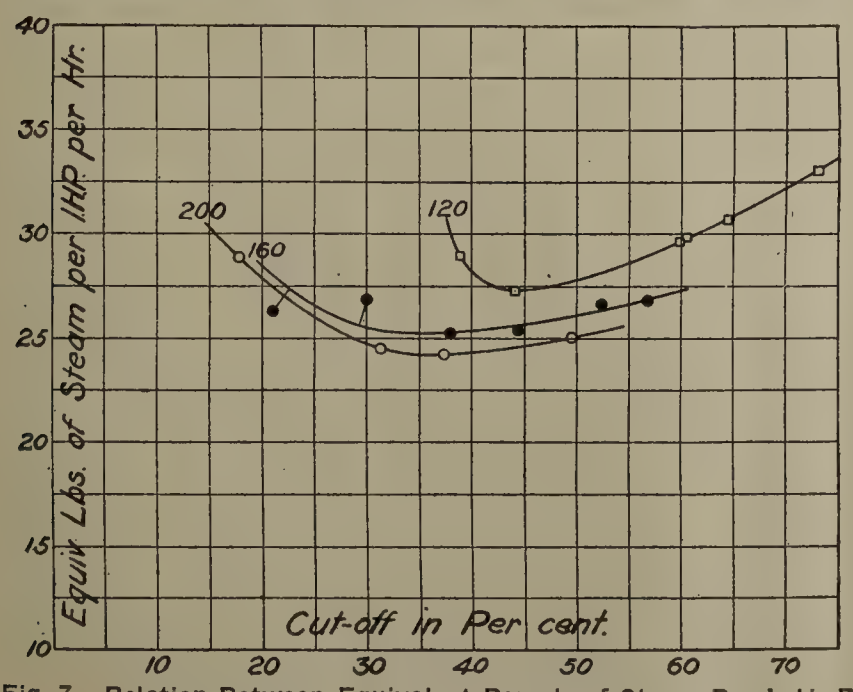


Fig. 7. Relation Between Equivalent Pounds of Steam Per I. H. P. Per Hour and Cut-off for the Engine Using Superheated Steam.

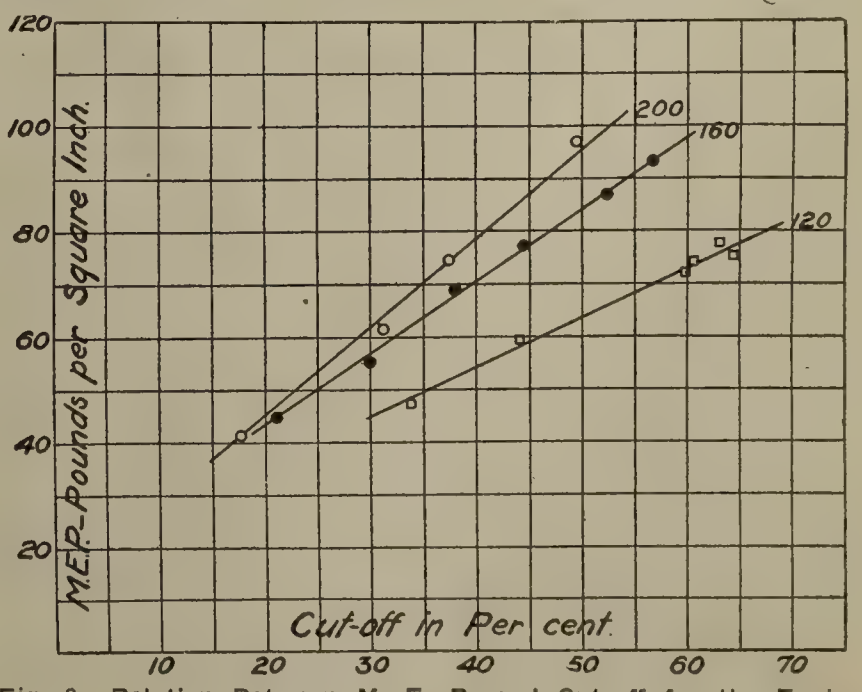


Fig. 9. Relation Between M. E. P. and Cut-off for the Engine Using Superheated Steam.

From the curve in Fig. 7, 24.9 pounds of steam per I. H. P. per hour;
From the line in Fig. 9, 92.2 pounds mean effective pressure.

$$\text{Thus, I. H. P.} = \frac{16325.1}{24.9} = 655.6.$$

Also, I. H. P. = 4 (92.2) (.012144) (146.2) = 654.6.

At 48.2 per cent cut-off we obtain from the curves in Fig. 7, 24.9 pounds of steam per I. H. P. hour, which gives I. H. P. = 655.6, and from the curves in Fig. 9, 92.7 mean effective pressure, which gives I. H. P. = 658.2.

By looking at the above sets of values, it can be seen that at 48 per cent cut-off the I. H. P. figured from the basis of pounds of steam per I. H. P. is greater than that figured from the basis of the M. E. P., and at 48.2 per cent cut-off just the reverse is true. Therefore, the proper values must lie somewhere between 48 and 48.2 per cent cut-off.

The proper value of 48.1 per cent cut-off was found to give the same I. H. P. figured from the pounds of steam per I. H. P. per hour as figured from M. E. P.; that is, with 48.1 per cent cut-off, the steam per I. H. P. per hour is 24.9 as obtained from the curve and gives an I. H. P. of 655.6. The M. E. P. at this cut-off is 92.4, and gives an I. H. P. of 656.0. These are so near the same that the 655.8 value was taken as the I. H. P. developed while burning 110 pounds of coal per square foot of grate. The four values mentioned above were used in the tables. The same process was used in determining the values for each line of Table V.

Column XV of Table V, which gives the per cent increase in indicated horsepower of the superheater locomotive over the other locomotive, when using the same amount of coal, equals Column XIV minus Column XIII divided by Column XIII and multiplied by 100.

DISCUSSION OF RESULTS.

Increased Power Due to Superheating.—It can be seen from Column XV, Table V, that the increase in power due to superheating, when burning from 110 to 130 pounds of coal per square foot of grate surface per hour, varies from 22.6 to 13.0 per cent. Also from the values in this column it can be seen that for any steam pressure the per cent increase of power decreases as the coal consumption increases, and that for any coal consumption, the increase of power increases as the steam pressure increases.

The Effect of Increasing Size of Cylinder for Maximum Power.—By comparing the values of equivalent pounds of steam per I. H. P. per hour it will be seen that they are considerably larger than the best performance of the locomotive as obtained at a lower cut-off; that is, the cut-off of maximum efficiency for 160 pounds steam pressure is approximately 37 per cent, while the cut-off as obtained under 120 pounds of coal per hour is 55.5 per cent. The relative steam consumption for these two values of cut-off is 25.2 and 26.7 pounds per I. H. P. hour, respectively. It will be seen that the increase in power to be accomplished by having the cut-off at the proper point to give maximum efficiency is about 5.6 per cent, as shown in Column VIII. That is, $\frac{26.7 - 25.2}{26.7} \times 100 = 5.6$ per cent. In order to show this more clearly, the values in Table VI have been worked out.

Columns I, II, III and IV were taken from Columns II, VIII, X and XII, respectively, in Table V, at 120 pounds of dry coal per square foot of grate surface per hour. The values in Column V, which give the cut-off at maximum efficiency, were taken at the lowest points of the curves in Fig. 7. The values in Column VI, which give the equivalent pounds of steam per I. H. P. per hour at maximum efficiency, were taken from the curves in Fig. 7 at the points of cut-off shown in Column V. The values in Column VII, which give the M. E. P. at maximum efficiency, were taken from the curves in Fig. 9 at the points of cut-off shown in Column V. The values of Column VIII, which give the per cent increase in indicated horsepower, equals Column III minus Column VI divided by Column III and multiplied by 100. The values in Column IX, which give the diameter of cylinders necessary to obtain maximum efficiency, equals sixteen times the square root of values given in Column IV divided by the square root of values given in Column VII. The following sample calculation will show this more clearly. The diameter of the cylinders at present is 16 inches. The ratio of this to the new diameter required to give the same indicated horsepower must be inversely proportional to the square roots of the mean effective pressures. For 200 pounds pressure

$$\frac{X}{16} = \frac{\sqrt{96.0}}{\sqrt{70.0}} = \frac{9.86}{8.38}$$

$$X = 18.82$$

where X is the new diameter of cylinder.

The average of the three values in Column IX is about 18¾ inches. Now, if the locomotive were equipped with 18¾-inch cylinders, when using 120 pounds of coal per square foot of grate, the cut-off could be at the most efficient point to obtain maximum power.

Under these conditions there would be an increase in power as shown in Table VII, or, in other words, the increase in power of the superheater locomotive over the other for the 160 and 200 pound pressures would be 25 per cent if the size of the cylinders were increased to 18¾ inches, whereas at present the increase is about 20 per cent.

Table VII, showing the increase of power of the superheater locomotive over the other when using 120 pounds of coal per square foot of grate per hour if the cylinders were increased to 18¾ inches, is given below:

TABLE VII.

Steam Pressure.	I. H. P. Sat.	I. H. P. Sup.	Per Cent Increase in I. H. P.
200	567.8	217.0	26.3
160	553.1	689.0	24.5
120	487.2	636.0	30.0

Discussion.

Prof. Benjamin, in reading the paper, stated that they had come to practically the same conclusions as had been arrived at in Mr. Young's paper concerning the work done at the Altoona testing plant of the Pennsylvania.

J. F. DeVoy (C., M. & St. P.)—This report contains one point of special interest to the Milwaukee road. We are now equipping saturated engines with superheaters, and from what we have gathered since coming here, we had better throw away the cylinders and build new cylinders with an increased diameter.

W. C. A. Henry (Penn.)—In working out plans for changing some of our engines over to superheaters we are using a 2-inch greater cylinder diameter than before and expect to hold the same steam pressure.

E. W. Pratt (C. & N.-W.)—We had a number of Pacific type engines, both saturated and superheater, but all the saturated engines have now been changed over. The superheaters with 2-inch larger cylinders give a slightly greater drawbar pull.

F. F. Gaines (Cent. of Ga.)—It seems to be indicated from the report that larger cylinders are necessary, as they effect greater economy.

C. D. Young (Penn.)—I think we may be able to increase the volume by increasing the stroke. On the Pennsylvania we are increasing the size of cylinders on our freight engines and it has resulted in a material increase in tractive power.

J. F. DeVoy (C., M. & St. P.)—With regard to the factor of adhesion, I believe that we should take the greatest unit of power out of the locomotive that is possible. With an engine which is built for long grades and sustained effort, we can afford to reduce the factor of adhesion. My opinion, of course, applies to the section of the country through which our road runs. In our western territory the atmosphere is drier and we don't get the fogs which you do in some other sections.

G. W. Wildin (N. Y., N. H. & H.)—The application of the superheater to the locomotive adds from 3,000 to 5,000 pounds. We had some Pacific engines which were turned over to superheaters. We retained the cylinder pressure and increased the cylinder diameter one inch, thereby obtaining a 25 per cent greater hauling capacity.

L. E. Endsley—With regard to the reduction in pressure, our tests show that the difference in efficiency of the locomotive as a whole between 160 and 200 pounds is so small that you can reduce the pressure and not lose much.

Our tests were run at about 30 miles per hour, which was the speed which gave the minimum steam consumption for the saturated engine, and I think it is about the same with the superheater. Boiler efficiency is not affected by steam, as it is merely the rate at which you can put in coal. If put in at a high rate of firing the efficiency will increase, and if you attempt to maintain the same cut-off at higher rates you will increase the coal consumption and decrease the efficiency of the boiler.

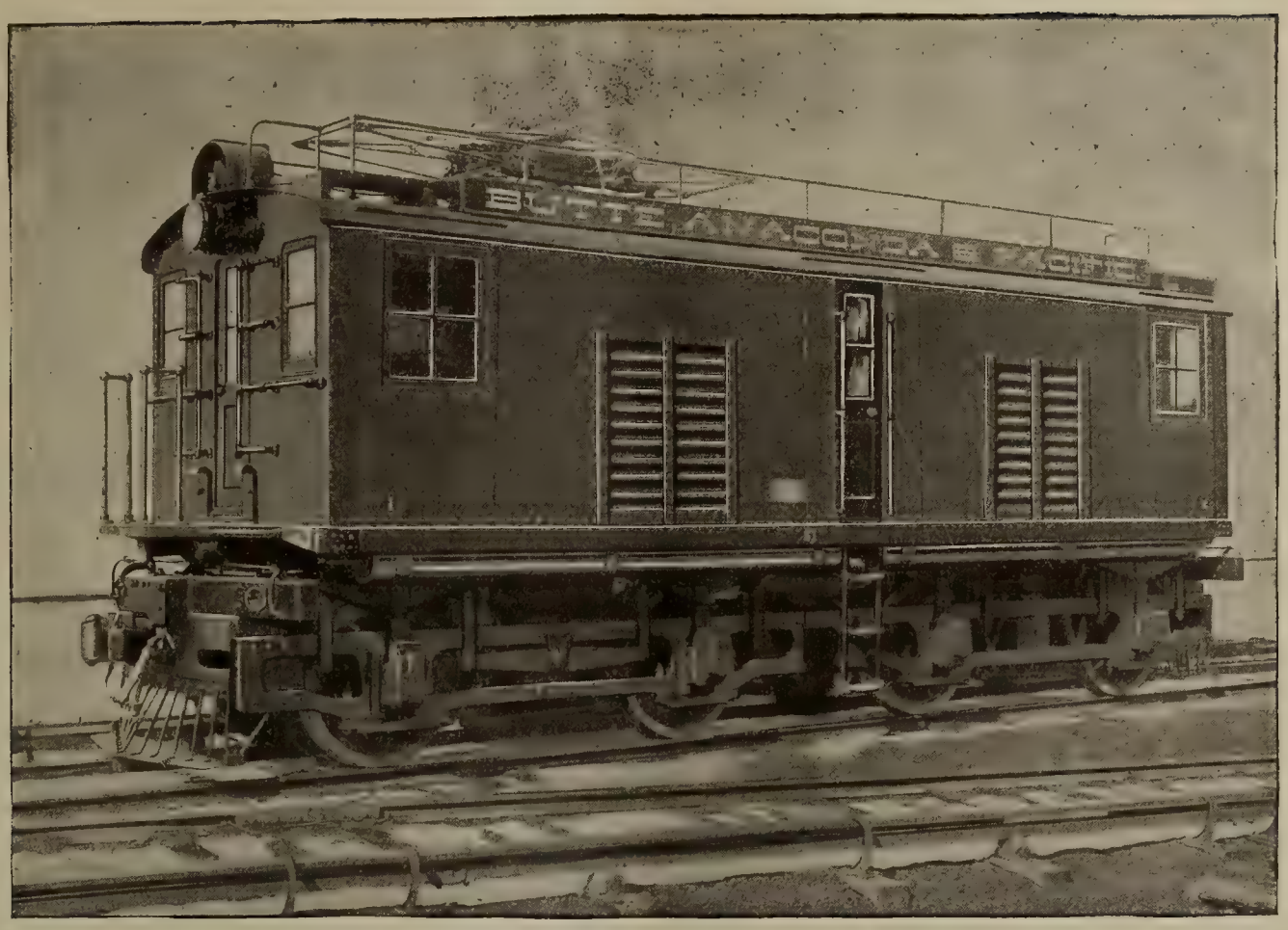
F. F. Gaines—I move that a vote of thanks be extended to Dean Benjamin and Prof. Endsley for their excellent paper.

This motion was carried.

ELECTRIFICATION OF THE BUTTE, ANACONDA & PACIFIC.

The electrification of the Butte, Anaconda & Pacific Railway is of exceptional interest because it represents one of the largest installations of electrical equipment for steam railroad service and the first in this country where direct current locomotives operating on as high a potential as 2,400 volts will be employed. Construction work necessary to effect the change from steam to electric equipment is now completed.

The adoption of the 2,400-volt direct current system for this railway was determined after a comprehensive study of local conditions and requirements. The traffic demands are unusually severe and consist principally of hauling long trains of copper ore over heavy mountain grades. In comparison with other existing systems, the 2,400-volt direct current system was considered best suited for exacting service of this character; for its adoption presented an opportunity to realize unusual economies both in initial expenditure and the cost of operation.



Side View of 2400-Volt Direct Current Locomotive, B. A. & P. Ry.

The section of the road that has been equipped lies between Butte and Anaconda, Mont. It comprises 30 miles of main line single track, and numerous sidings, yards and smelter tracks, aggregating a total of about 90 miles on a single track basis. The haulage of copper ore from the Butte mines to the smelters at Anaconda, together with all mine supplies, lumber, etc., moving in both directions, amounts to practically 5,000,000 tons of freight per year. Complete freight trains weighing 3,400 tons are made up of fifty loaded steel ore cars and are handled against a ruling grade of 0.3 per cent by a locomotive consisting of two of the units illustrated. Single units are used for making up trains in the yards and for spotting cars.

The initial equipment consists of seventeen locomotive units, Type 0440-E-160-4 GE 229A, fifteen for freight and two for passenger service. Each unit weighs approximately 80 tons. The two units for forming the freight locomotives in each case will be coupled together and operated in multiple unit. The combination freight locomotives will haul the usual trains of 3,400 tons at a maximum speed of 15 miles per hour against the ruling grade and at 21 miles per hour on level tangent track.

The passenger locomotives are the same design as the freight locomotives, except they are geared for a maximum speed of 45 miles per hour on level tangent track. A schedule of eight passenger trains per day, four each way, is maintained, the average train being composed of a locomotive and three standard steam road passenger coaches. All the locomotive equipment, as well as the substation apparatus and overhead line material, was designed and built by the General Electric Company.

The locomotives are the articulated double truck type with all weight on the drivers. The cab, containing an engineers compartment in each end and a central compartment for the control apparatus, is carried by the two truck frames on center pins. It is the box type, extending the entire length of the locomotive, and is provided with end and side doors. On each axle is mounted a motor of the twin geared type. The friction draft gear mounted on the outer end frame of each truck transmits the hauling and buffing stresses directly through the truck frame, diverting these strains from the center pins and underframe.

The trucks are built of heavy steel castings. The side frames are of a truss pattern with heavy top and bottom members and pedestal tie bars. They are connected by end frames and a cast steel center transom. The entire weight is carried on semi-elliptic springs suitably equalized.

The cab underframe consists of two 12-inch longitudinal steel channels on either side of the center and two 6-inch by 6-inch steel angles along the outer edges. The central channels are enclosed and form a distributing air duct for forced ventilation. Air is conducted through the center pins, which are hollow, into the truck transoms and thence to the motors.

The engineer's compartment, at either end of the cab, contains the operator's seat, controller, air brake valves, bell and whistle ropes, ammeter, air gauges, sanders and other control apparatus that should be within immediate reach of the engineer. These compartments are comfortably heated by electric heaters.

In the central section is grouped the control apparatus. The contractors, reverser and rheostats are mounted in two banks running lengthwise of the compartment and are arranged with ample space between them to afford convenient access for cleaning, inspection and repair. All parts and circuits carrying 2,400 volts are thoroughly protected from accidental contact. A dynamotor is employed to furnish 600 volts for the operation of the contactors, lights and air compressor.

The principal data and dimensions applying to the locomotives are the following:

Length inside of knuckles	37 ft. 4 in.
Length of cab	31 ft.
Height over cab	12 ft. 10 in.
Height with trolley down	15 ft. 6 in.
Width over all	10 ft.
Total wheel base	26 ft.
Rigid wheel base	8 ft. 8 in.
Track gauge	4 ft. 8½ in.
Total weight	160,000 lbs.
Weight per axle	40,000 lbs.
Wheels, steel tired	46 in.
Journals	6 in. by 13 in.
Gears, forged rims, freight locomotives	87 teeth.
Gears, forged rims, passenger locomotives	80 teeth
Pinions, forged, freight locomotives	18 teeth.
Pinions, forged, passenger locomotives	25 teeth.
Tractive effort at 30 per cent coefficient	48,000 lbs.

Tractive effort at one hour rating.....30,000 lbs.
Tractive effort at continuous rating.....25,000 lbs.

The motors are the GE-229-A commutating pole type, wound for 1,200 volts and insulated for 2,400 volts. A forged pinion is mounted on each end of the armature shaft and meshes into a corresponding gear mounted on the wheel hub. The gear reduction is 4.84 on the freight locomotives and 3.2 on the passenger locomotives.

The GE-229-A motor is designed especially for locomotive service, is enclosed and provided with forced ventilation. Air is circulated over the armature and field coils, over and through the commutator, through longitudinal holes in the armature core, and thence exhausted through openings in the bearing head. This method of ventilation circulates effectively a large volume of cool air throughout the motor and keeps all parts at a uniform temperature, eliminating the possibility of "hot spots."

The continuous capacity of each motor is 190 amperes on 1,200 volts under forced ventilation, and 225 amperes on 1,200 volts for the one hour rating. For the double unit 160-ton locomotive this is equivalent to a continuously sustained output of 2,100 horsepower.

The control equipment on the locomotives is the well-known Sprague-General Electric Type M multiple unit control, and is designed to operate the four motors in series and series-parallel. The pairs of motors with their respective resistances are all connected in series on the first point of the controller. The resistance is varied through nine points on the controller and finally short-circuited on the tenth or running point. The pairs of motors are then operated similarly in series-parallel and all resistances is cut out on the nineteenth point, which is the full speed running point. This provides a control with ten steps in series and nine steps in series-parallel.

The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. The smooth transition between control points permits acceleration close to the slipping point of the wheels. A switch is provided having manually-operated handles for cutting out either pair of motors, so that the locomotive can then be operated with one pair of motors in the usual way.

The contractors are actuated by the 600-volt circuit obtained from the dynamotor and are of a design similar to that employed in the standard Type M control. The principal variations are embodied in the method of insulating for the higher voltage. The arm between the operating armature magnet and the arc chute mechanism consists of a treated wood spacer insulator; and the contacts and magnetic blowout, which make and break on the 240-volt circuit, are mounted on mica and porcelain insulators.

There is one main fuse for the trolley circuit and two fuses for the motor circuits. They are all of the copper ribbon type and are fitted with hinged covers to facilitate fuse renewals. The boxes are located as near as possible to the overhead trolley in order to protect the wiring circuits near the source of supply. There is also an auxiliary circuit fuse for protecting locally the dynamotor and heater circuits. The main, motor and auxiliary fuse boxes are provided with powerful magnetic blowouts, energized by current passing through the fuse, to insure proper rupture of the arc.

An ammeter is located at each engineer's position and indicates the current in the circuit of one pair of motors. The ammeter and air gauges are illuminated by a gauge light connected in the headlight circuit, so that the headlight switch turns on simultaneously the headlight and gauge light at the same end of the locomotive.

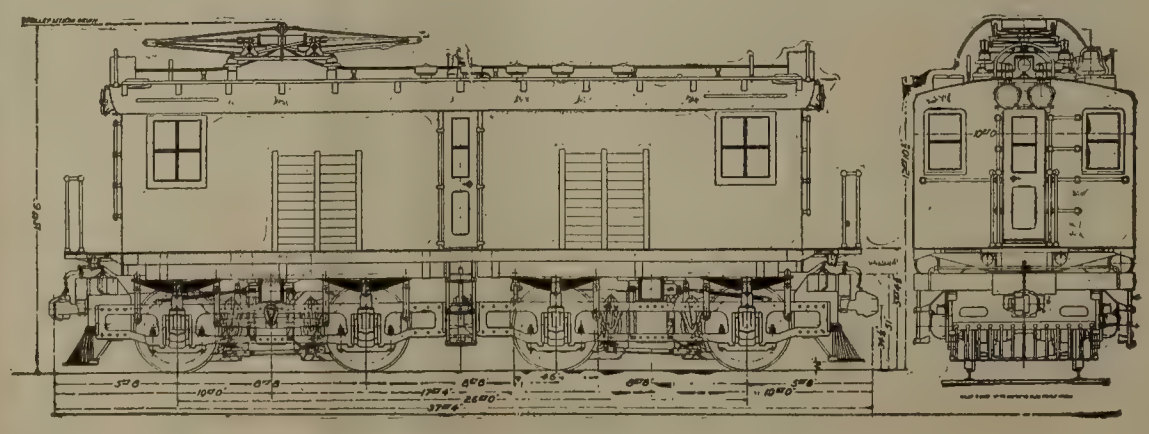
The main motor rheostats are formed of cast iron grids assembled in a frame and insulated by mica. Twenty resistance units are provided for each passenger locomotive, and twenty-six resistance units for each freight unit. The rheostat boxes are mounted in an enclosed compartment above the banks of contactors.

Current is collected by overhead trolleys of the pantograph type. They are pneumatically operated and can be put into service from either engineer's compartment by a hand-operated valve. Each passenger locomotive is equipped with two collectors, and each freight unit with one collector. A 2,400-volt insulated bus line connected direct to the pantographs is run along the center on the roof of the cab. The bus lines are connected by couplers between the two units of the freight locomotive, so that current is obtained from both collectors or from a single collector. The collectors and bus lines are adequately guarded by railings.

The locomotives are equipped with arc headlights. The interior illumination of the cab is provided by ten incandescent lamps arranged in two circuits, one lamp being placed in each engineer's cab and the balance in the central compartment. In each lamp circuit is a portable lamp with an extension cord. One lamp switch is located in each engineer's cab, so that one lamp circuit can be controlled from each end of the locomotive. A 600-volt bus line is provided on the passenger locomotives for lighting and a 2,400-volt bus line for heating the passenger coaches.

The air brakes are the combined straight and automatic type. The air compressor, of the CP-26 type, is two-stage, motor driven, and has a piston displacement of 100 cubic feet of air per minute when pumping against a tank pressure of 135 pounds per square inch. Air is taken from the interior of the central compartment through a screen, which prevents the entrance of particles of dust. The compressed air in passing from the low pressure to the high pressure cylinder is conducted through radiating pipes on the roof of the cab. This reduces the temperature of the air and allows condensation of moisture before entering the high pressure cylinder. From the high pressure

End View of B. A. & P. Ry., 2400-Volt Locomotive.



Outline of 2700-Volt Locomotive B. A. & P. Ry.

cylinder it is delivered into four air reservoirs, each 12 inches by 164 inches. They are located under the floor of the cab and connected in series, which affords a further opportunity for radiation and condensation.

Pneumatic sanders are provided. The sander valves are located within convenient reach of the engineer's seat, and valves and boxes are arranged for sanding the track in front of the leading wheels when running in either direction. The couplers are M. C. B. standard. The bells are fitted with automatic bell ringers, and the whistles are air-operated. All wiring is drawn through conduits and carefully protected from possible mechanical injury.

Personals

GEORGE THOMSON has been promoted assistant master car builder of the Lake Shore & Michigan Southern and the Chicago, Indiana & Southern with office at Englewood (Chicago), Ill. Mr. Thomson was formerly foreman car department at the same place.

S. L. KAMPS has been appointed inspector of transportation of the Chicago Great Western with office at the Peoples Gas Building, Chicago.

WM. BAUMBERGER succeeds P. J. Ryan as road foreman of engines of the Lake Erie & Western with office at Lima, O.

J. J. WELSH has been appointed district car foreman of the Minneapolis & St. Louis at Marshalltown, Ia., succeeding E. E. Turney.

F. G. KUMKEL succeeds W. A. Yanda as machine shop foreman of the Minneapolis & St. Louis at Marshalltown, Ia.

W. C. GROENING has been appointed master mechanic of the Pere Marquette at Wyoming, Mich., vice J. E. Hickey, resigned.

G. H. GOODWIN succeeds W. F. Merry as general foreman locomotive shops of the Southern Pacific at Los Angeles, Cal.

W. F. MERRY has been appointed master mechanic of the Southern Pacific at Los Angeles, Cal. He succeeds T. O'Leary.

J. W. HIGHLEYMAN succeeds L. E. Butler as assistant master mechanic of the Union Pacific at Cheyenne, Wyo.

J. COLE has been appointed superintendent of motive power of the Vera Cruz with office at Alvarado, Mexico.

H. SCHAEFER, master mechanic of the Atchison, Topeka & Santa Fe, has been transferred from Wellington, Kan., to Clovis, N. M., succeeding Jas. Kiely.

H. H. STEPHENS has been appointed master mechanic of the Atchison, Topeka & Santa Fe at Wellington, Kan., succeeding Hugo Schaefer.

M. H. OAKES has been appointed assistant master mechanic of the Baltimore & Ohio at Cumberland, Md. He succeeds W. W. Neale.

The jurisdiction of H. B. Voorhees, general superintendent of the Baltimore & Ohio Southwestern, has been extended over the Cincinnati, Hamilton & Dayton and the Cincinnati Terminal division.

G. A. GIBSON has been appointed roundhouse foreman of the Central Vermont at White River Junction, Vt. He succeeds H. G. Cross.

M. ROBERTS has been appointed locomotive foreman of the Chicago Great Western at Hayfield, Minn. He succeeds C. Ruff.

E. D. BARNES succeeds Maurice E. McMartin as car accountant of the Chicago, Kalamazoo & Saginaw, with office at Kalamazoo, Mich.

G. W. LILLIE has been appointed acting mechanical superintendent of the second district of the Chicago, Rock Island & Pacific, vice C. M. Taylor, granted a leave of absence. Mr. Lillie's headquarters are at Topeka, Kan.

G. A. HULL has been appointed acting assistant mechanical engineer of the Chicago, Rock Island & Pacific with headquarters at Silvis, Ill., vice G. W. Lillie.

The office of C. W. Jones, general manager of the third district, Chicago, Rock Island & Pacific, has been transferred from Ft. Worth, Texas, to El Reno, Okla.

FRED SAMWAYS succeeds J. O. Brand as foreman painter of the Duluth, Missabe & Northern, at Proctor, St. Louis Co., Minn.

J. B. QUACKENBUSH has been appointed road foreman of engines of the Erie at Jersey City, N. J.

M. P. HEALY has been appointed road foreman of engines of the Erie at Buffalo, N. Y., succeeding J. Lang.

P. D. GREGG has been appointed road foreman of engines of the Erie at Marion, O., succeeding F. E. Smythe.

E. J. MCVEIGH has been appointed general storekeeper of the Grand Trunk with office at Montreal, Que.

JAMES M. FORD has been promoted to assistant road foreman of engines of the Northern Pacific for temporary service on the St. Paul division.

J. F. GRAHAM, formerly assistant general manager of the Oregon-Washington R. R. & N., in charge of mechanical matters, has had his title changed to superintendent of motive power. His office as before is at Portland, Ore.

J. T. LANGLEY has had his title changed to assistant superintendent of motive power of the Oregon-Washington R. R. & N. His office remains at Portland, Ore., as before.

F. A. Leavitt succeeds J. F. Killeen as general foreman of the Oregon-Washington R. R. & N. His office is at Starbuck, Ore.

R. B. SALMONS succeeds W. H. Dunlap as master mechanic of the Louisville & Nashville with office at Covington, Ky.

A. L. LANGDON has been appointed storekeeper of the Southern Pacific of Mexico, with office at Empalme, Son., Mexico.

E. FULLER, master mechanic of the Southern, has been transferred from Charleston, S. C., to Alexandria, Va.

J. E. BREYSER succeeds E. Fuller as master mechanic of the Southern at Charleston, S. C.

W. P. MCDEVITT succeeds J. E. Breyer as general foreman of the Southern at Macon, Ga.

H. C. PEARCE has been appointed general purchasing agent of the Seaboard Air Line with office at Norfolk, Va. He will have charge of both purchases and stores.

H. G. COOK succeeds H. C. Pearce as general storekeeper of the Southern Pacific with office at San Francisco.

H. J. OSBORNE succeeds L. J. Shannon as superintendent of motive power of the South Dakota Central with office at Sioux Falls, S. D.

P. T. DUNLOP has been appointed general superintendent of motive power of the St. Louis & San Francisco, vice George A. Hancock, resigned on account of ill health. Mr. Dunlop was formerly mechanical superintendent of the Gulf, Colorado & Santa Fe. His office is now at Springfield, Mo.

F. S. ROBBINS has been appointed assistant master mechanic of the Pittsburgh division of the Pennsylvania with office at Pittsburgh. He succeeds C. D. Porter, promoted.

J. H. THOMAS has been appointed assistant general foreman of the Pennsylvania at Pitcairn, Pa., succeeding F. S. Robbins.

WM. P. HAWKINS has been appointed assistant fuel agent of the Missouri Pacific with office at St. Louis, Mo., succeeding W. J. Jenkins.

A. A. GOODCHILD has been appointed general storekeeper of the Canadian Pacific lines east of Ft. William, Ont., with office at Montreal, Que. He succeeds M. J. Power, deceased.

B. F. BUSH has been elected president of the Western Pacific, succeeding E. T. Jeffery. Mr. Bush is also president of the Missouri Pacific System.

C. D. PORTER has been appointed assistant to the general superintendent of motive power of the Pennsylvania with office at Altoona, Pa. Mr. Porter was formerly assistant master mechanic at Pittsburgh.

WM. M. MITCHELL has been appointed fuel supervisor of the Chicago Great Western with office at Chicago.

L. S. BROWN has been appointed superintendent of the Truro, Sydney and Oxford divisions of the Intercolonial Ry., vice Y. C. Campbell, transferred. His office is at New Glascow, N. S.

H. B. FLEMING has been appointed assistant superintendent of the National Transcontinental between Moncton and Edmundston.

J. L. CUNNINGHAM has been appointed master mechanic of the Wilmington division of the Philadelphia, Baltimore & Washington, with office at Wilmington, Del., succeeding C. G. Turner, resigned. Mr. Cunningham was formerly master mechanic of the New York, Philadelphia & Norfolk at Cape Charles City, Mo.

C. L. MCILVAINE has been appointed master mechanic of the New York, Philadelphia & Norfolk at Cape Charles City, Va., succeeding J. L. Cunningham.

W. T. LEYDEN has resigned as master mechanic of the Minneapolis & St. Louis at Marshalltown, Ia.

SAMUEL PORCHER succeeds the late D. S. Newhall as purchasing agent of the Pennsylvania, with office at Philadelphia, Pa.

HOWARD ELLIOTT, president of the Northern Pacific, has been elected president of the New York, New Haven & Hartford, effective Sept. 1. It is announced, however, that a change in the by-laws of the company will be made in October and that Mr. Elliott will then be elected chairman of the board of the entire New Haven system.

JAMES H. HUSTIS, vice-president of the Boston & Albany, is to become president of the New York, New Haven & Hartford on Nov. 1, according to the present plans of the directors.

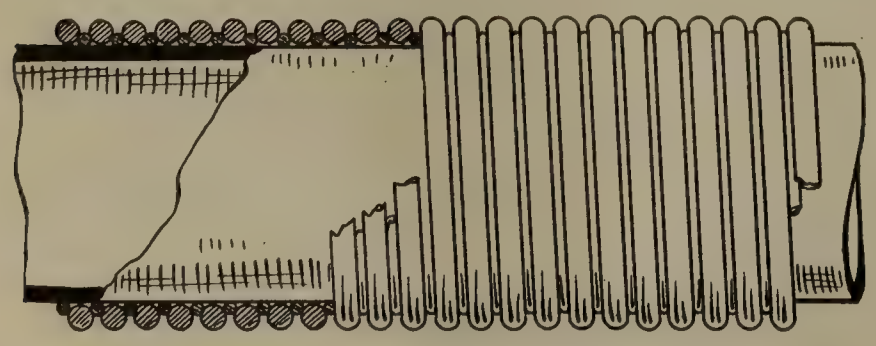
D. T. MAIN, master mechanic of the Canadian Pacific, has been transferred from Moose Jaw, Sask., to Vancouver, B. C., on the British Columbia division. He succeeds S. Phipps, retired.

M. J. SCOTT, master mechanic of the Canadian Pacific, has been transferred from Revelstoke, B. C., to Moose Jaw, Sask., on the Saskatchewan division. He succeeds D. T. Main.

R. H. BRIGGS, who on July 1 retired as master mechanic of St. Louis & San Francisco at Memphis, Tenn., was tendered a reception on July 29 by the employes and officials of the Frisco. The program included vocal and instrumental music, and also speeches by H. H. Litty, C. R. Crowley and D. E. Fitzgerald, assistant general superintendent of motive power. Mr. Briggs was born at Schenectady, N. Y., Feb. 2, 1833, and commenced work at the age of 16 as an apprentice at the Schenectady Locomotive Works. Afterward he worked in various parts of the country and in 1854 entered the service of the Wilmington & Manchester R. R. as a locomotive engineer. Later he went to the Montgomery & West R. R. and also the Mobile & Girard R. R. From 1863 to 1865 he had charge of repairs to government steamers at New Orleans, and from 1865 to 1883 was connected with the Mobile & Ohio R. R., where he rose from machinist to general master mechanic. In 1883 he went to the Chesapeake & Ohio Southwestern as superintendent of motive power, and in 1886 became master mechanic of the Santa Fe at Argentine, Kan., where he remained until 1888, when he went to Memphis, where he brought to a close his railroad career.

"KANTKINK" FLEXIBLE METALLIC HOSE.

Among the new exhibitors at the recent Atlantic City conventions was the Goodyear Tire & Rubber Co., of Akron, O., which has recently gone into the manufacture of all classes of mechanical rubber goods. Its exhibit of "Kantkink" flexible hose attracted a great deal of favorable attention. This hose is designed for air, steam and water and for use in connection with the pneumatic tools, wash-out systems and all conditions where high service duty is required. The method of armoring the hose is shown in the sketch and consists of compound, high carbon wires effectively galvanized, which completely protect the inner hose. There is an entire absence of edges and any manner of kinks and knots may be made in the hose without effecting it in the least. Elongation cannot occur, and it is said that a pressure equal to 1,000 pounds will not burst it. The inner hose is made of Goodyear standard, is of high tensile strength and of quality adaptable for the particular service desired. The flexibility of the hose was fully appreciated by those who handled it at the Goodyear booth. Innumerable tests were made by the Goodyear engineers before it was offered to the public, as has been the case with all Goodyear products.



Showing Construction of "Kantkink" Hose.

New Literature

The Smooth-On Mfg. Co., of Jersey City, N. J., has printed a pamphlet of extracts from instruction book number 12, containing short descriptions of the iron cements manufactured by this firm.

* * *

Bulletin 1013 of the American Locomotive Co., New York City, is devoted to information and illustrations of the latest Mikado type locomotives built by this company.

* * *

The Gold Car Heating & Lighting Co., of New York, has issued a number of circulars covering the following subjects: Wedge lock couplers, curtain window ventilators, thermostatic car temperature regulating system, simplex ventilated steam trap No. 912, cut-out valve No. 870 and a comparative diagram showing the action of the Gold steam coupler's oscillating gasket and the non-oscillating soft gasket.

* * *

The Moore Patent Car Co., St. Paul, Minn., has issued supplement No. 5 to its regular catalog. This supplement covers the performance of the Moore circulating refrigerating system on the Burlington.

* * *

Record No. 75 recently issued by the Baldwin Locomotive Works, Philadelphia, Pa., is devoted to Mikado type locomotives. The information contained covers a large number of locomotives of this type recently built by the Baldwin people.

* * *

The C. F. Pease Co., Chicago, has issued a complete catalog of its blue printing machinery and supplies. These include blue printing machines of all sizes, white print machinery, lamps, frames, trays, ovens, washers, cutters, trimming tables, coating machinery, paper and everything necessary for the drawing room.

* * *

"Staybolts" is the title of an eight-page booklet issued monthly by the Flannery Bolt Co., of Pittsburgh, and it is devoted to news of interest with regard to the Tate flexible staybolt.

* * *

The Chicago Pneumatic Tool Co. has issued Bulletin No. 127 dealing with pneumatic drills, reamers, wood borers, flue rolling and tapping machines and grinders.

* * *

The Milton Mfg. Co., Milton, Pa., has issued catalog No. 27, descriptive of the nuts and washers manufactured by it, including cold punched and hot pressed nuts in both square and hexagon shapes. The supplement to this catalog shows revised list prices on hot pressed nuts, cold pressed nuts and semi-finished nuts.

"The Successful Use of Cling-Surface in Railroad Shops" is an eight-page booklet issued by the Cling-Surface Co., Buffalo, N. Y. It illustrates noteworthy examples of the benefits of Cling-Surface in five prominent railroad shops and describes every installation in detail. On the last page over forty big railroads are listed which use this treatment.

* * *

Catalog No. 2, issued by Armstrong Bros. Tool Co., Chicago, covers a complete line of drop forged steel wrenches, giving illustrations, descriptions and prices.

* * *

The Boyer railway speed recorder contains a gauge similar in appearance to a steam gauge, showing the engineer the speed of his train and a chart upon which is recorded the exact speed at all points of the trip. The Boyer recorder is described in a recent booklet of the Chicago Pneumatic Tool Co., Chicago.

* * *

Catalog No. 22 of the National Malleable Castings Co., Cleveland, O., is entitled "Malleable Iron Castings for Air Brake Equipment." This firm also issues catalogs covering castings for the following: "Couplers and Parts," "Coupler Release Rigging," "Hand Brake Mechanism," and "Car Door Brackets."

* * *

A very interesting booklet has been issued by the Cooper Hewitt Electric Co., Hoboken, N. J., entitled "Industrial Lighting." It contains some thirty pages and can be read with profit by many connected with shop management, as the question of shop lighting can bear to have considerable light thrown upon it. Among phases touched upon are conditions of distinct vision, effect of glare, faults of individual lighting, importance of diffusion and effect of color on vision.

Industrial Notes

The Crawford Locomotive & Car Co., of Streator, Ill., has opened offices at 1609 Merchants' Bank building, Indianapolis, Ind., preparatory to starting work on its new plant at Mars Hill. S. E. J. Cox is in charge of the Indianapolis office. Plans for the new plant are going forward and actual construction work probably will begin soon. The main building will be 200x1,500 feet and will be used for the manufacture of steel cars. The second building will be 150x1,000 feet and will be used for the reconstruction and building of wooden freight cars.

The railway supply business of Fred Gardner, 80 E. Jackson boulevard, Chicago, Ill., has been incorporated under the name of the Fred Gardner Co., with a capital of $2,500, to buy, sell and deal in railway supplies.

The Love Brake Shoe Co. has changed its name to the General Brake Shoe & Supply Co.

The courts have authorized the receivers of the Barney & Smith Car. Co. to spend $175,000 for plant improvements.

The General Electric Co., Schenectady, N. Y., has opened a branch office at Madison, Wis.

The Independent Pneumatic Tool Co., Chicago, has moved its motorcycle manufacturing department from its plant at Aurora, Ill., to a new plant in Chicago in order to permit further expansion in the manufacture of its Thor air and electric tools. The output of the Aurora plant will be increased to 1,500 air tools and 500 electric drills per month.

Frank B. Archibald, formerly of the sales department of the National Lock Washer Co., with office in 50 Church street, New York, has been appointed eastern manager of the company.

The H. W. Johns-Manville Co., New York, has opened a branch office in the Commercial Bank building, Charlotte, N. C., in charge of E. U. Heslop as manager.

The Osgood-Bradley Car Co. is to erect three eight-story buildings for store and manufacturing purposes on the site of the company's old plant in Grafton and Franklin streets, Worcester, Mass. The project will involve an expenditure of between $800,000 and $900,000.

The U. S. Metal & Manufacturing Co., New York, has recently added to its line of railway specialties the sale of the Lincoln arc welding and cutting machines, made by the Welding Materials Co.

The Western Steel Car & Foundry Co. is reported to have Ill., and will erect a new shop building, 120x360 ft., at a cost of prepared plans for the enlargement of its plant at Hegewisch, $60,000.

Edwin R. Rockwell, formerly president of the Guarantee Electric Co., Chicago, announces the formation of the Rockwell Electric Co., with office in the First National Bank building, Chicago. The firm will handle electrical machinery, and offers its services for electrical engineering in all branches.

L. C. Noble, vice-president of the Pittsburgh Spring & Steel Co., Pittsburgh, Pa., with office in Chicago, died at his home in Evanston, Ill., on July 19, after a brief illness. L. C. Noble was superintendent of motive power of the Houston & Texas Central for a number of years prior to 1890. In that year he became associated with the A. French Spring Co. as western manager of sales. In 1902 he resigned that position to become vice-president of the Pittsburgh Spring & Steel Co.

James H. Denton has been appointed eastern manager of the Railway Utility Co., Chicago, Ill., with offices in the Marbridge building, New York city.

The Titan Copper Products Co., Inc., Buffalo, N. Y., maker of brass, bronze and aluminum castings, has been organized by Charles V. Slocum, who for the past six years has been engaged in introducing titanium to the steel and iron trade. The officers of the company are as follows: President, Charles V. Slocum; vice-president, A. N. Slocum; treasurer, W. W. Slocum, and general superintendent, Frank P. Lund.

Eighteen minority stockholders in the Union Car & Equipment Co., applied for a receiver in the Circuit court at Chicago, July 24, alleging that the company's affairs are involved and that it has ceased to do business.

Jas. W. Carpenter, Who Has Guarded the Door of the Office of the President of the Baldwin Locomotive Works Since December 19, 1883.

Recent Railway Mechanical Patents

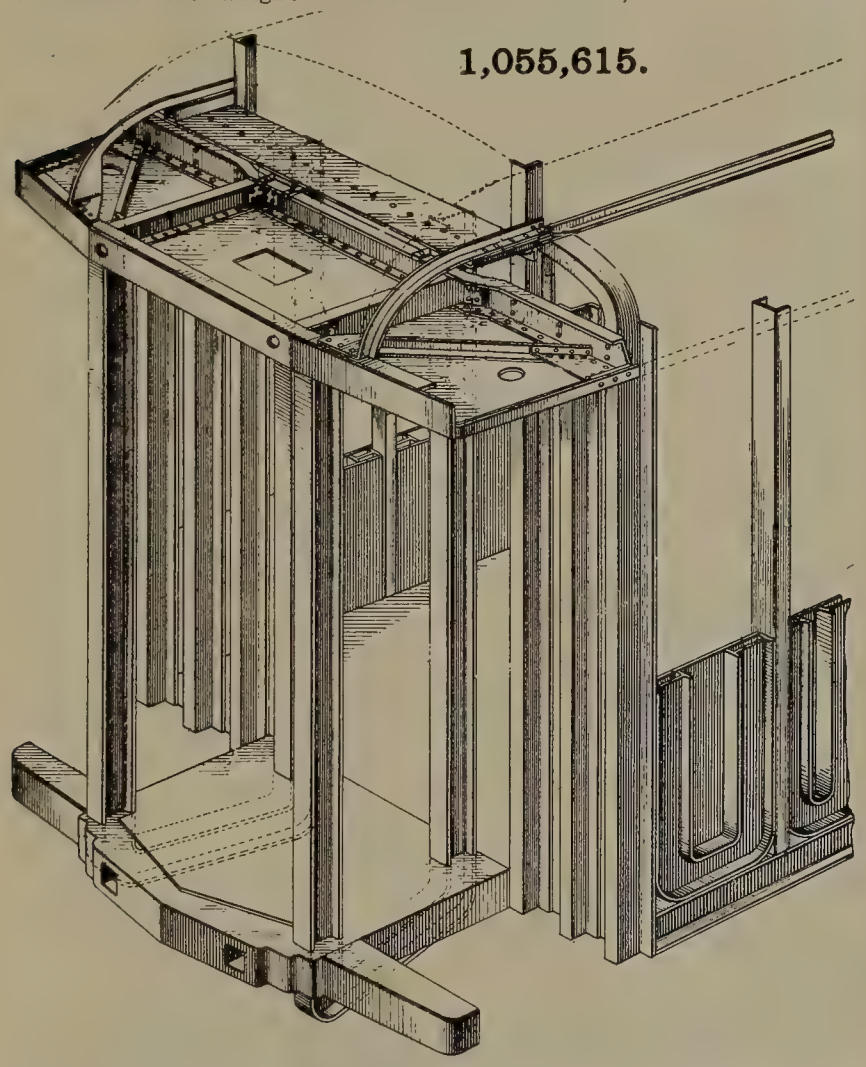
CAR.

1,055,615—Richmond Dean, Chicago, Ill., Assignor to the Pullman Company, of Chicago.

In substance this invention involves the plan of preventing the collapsing or battering down of the car-body end-wall in a collision, because if this occurs the resistance to the advance of the crushing car is materially decreased. The plan is to remove the surplus strength from the underframe and so construct and strengthen the vestibule, that the latter will act as a cushion to absorb and dissipate the force of impact.

A further object is to so reinforce the end-wall that it will also act as a buffing cushion and prevent the on-coming car from entering the main body against which it is thrust. It is not the intention to increase the weight of the car as a whole, but rather to re-

1,055,615.



distribute the weight of the various elements in the car construction and thereby more nearly equalize the strengths of the various parts.

Cushion members or bent beams are provided, preferably without joints, in the vestibule structure, whereby, to collapse or crush the vestibule, it is necessary to bend such relatively strong beams, such bending absorbing wholly or in part the blow imposed and deflecting the shock and the colliding car. In a structure of this character the breaking of riveted joints is not depended upon, but rather the bending of heavy beams (desirably rolled or other fabricated beams), is used for a cushioning effect or concussion dissipation. In a somewhat similar manner the car-body end-wall is strengthened and braced by similar shock-absorbing and deflecting cushions.

CENTER STOP FOR MACHINE TOOLS.

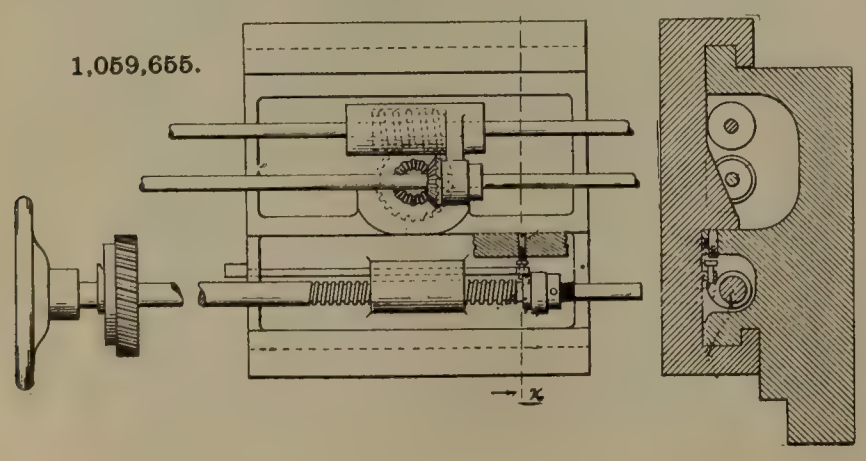
1,059,655—E. B. Bullard, Sr., Bridgeport, Conn., Assignor to the Bullard Machine Tool Co., Bridgeport, Conn.

This invention relates to improvements in boring mills, vertical turret lathes, horizontal lathes, and the like, and refers particularly to a means whereby the cutting tool of the machine may be brought to the center and accurately set in relation to the center of the table spindle. The improvements therefore include a special form of mechanism for positively determining the proper center position for, say a turret head, so that whether the same is run in, quick or slow, it will be positively caught and stopped in absolutely the same relative position every time. This mechanism includes the securing of a shouldered collar upon the feed screw, which collar may be threadably attached to the said screw and secured in such position by means of a nut as shown in the drawing.

A stop screw is arranged vertically in the outer end portion of the intermediate or center bearing of the cross rail, and is adapted to be adjusted vertically by the use of a screw driver and then set and secured in position by a second and smaller set screw and is also shown in the figure. This adjustment is for accurately setting the parts to stop at a particular time and place.

A slide rod is adjustably mounted in the before mentioned lug and in the outer flange of the saddle, thus being adapted to be shoved backward and forward as occasion may require. One end of this slide is slightly enlarged and provided with a vertical hole therethrough to receive a pin which is loosely seated therein and thus carried by the slide rod. Therefore when it is necessary to set the device so that the tools will stop over the center of the table this rod is shoved into the position shown in the figure. On the other hand if it be desirable to run the saddle past the center, the slide rod is slipped out or to the left, bringing the pin out of alignment with the collar and stop screw, thereby allowing the saddle to run past for a short distance.

1,059,655.



DEVICE FOR OILING SHAFT-BEARINGS.

1,054,079—Frank R. Ashton, of Rochester, New York.

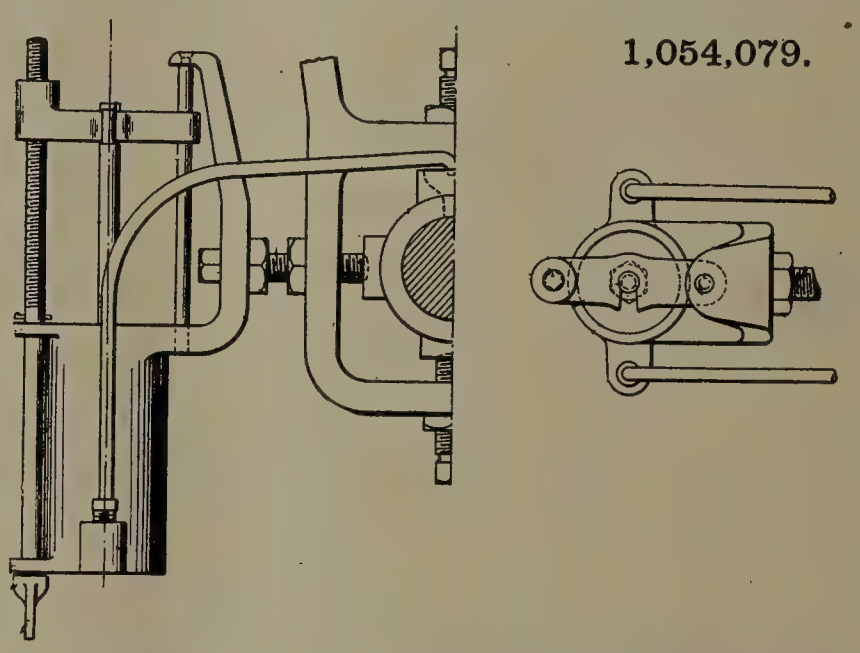
This invention relates to devices for oiling shaft-bearings, of the type adapted to be mounted upon a shaft-hanger and to be operated from below when it is desired to feed oil to the shaft-bearing in the hanger.

One object of the invention is to produce a shaft-oiler of simple and inexpensive form, and to this end arrangement of the piston is employed, by which the oil is forced from the oiler, and of the means by which the piston is actuated.

Another object of the invention is to provide, in a convenient and simple manner, for filling the oil-cylinder or reservoir with oil, and to this end there is employed, in connection with the piston, a piston-rod, and an actuating-yoke with which the piston-rod is detachably connected.

There is a single cylindrical oil-receptacle, which is provided at the bottom with two lateral projections perforated to provide oil-outlets. From these outlets, tubes project upwardly to the point of discharge of the oil. The oiler is shown as used in connection with

1,054,079.



a shaft-hanger having the usual shaft-bearing, and the oil-tubes extend to a point where they may discharge into the two oil-holes usually provided in such a bearing. As a convenient means for mounting the oiler upon the shaft-hanger it is provided with a long screw, which may be substituted in one of the usual adjusting-screws of the shaft-hanger, this screw passing through an opening in a bracket projecting from the upper end of the cylinder, and being locked in position therein by means of a lock-nut. The oil is expelled from the cylinder through the oil-tubes by means of a piston and this piston is actuated by a piston-rod, which projects upwardly and has a portion of reduced diameter at its upper end, this portion terminating, above and below, in shoulders. This is operated by the thumb screw shown at the bottom of the cylinder.

The Harlan & Hollingsworth Corporation, Wilmington, Del., is planning extensive reorganization in view of increasing facilities both for ship and car building. The present capacity as to length of vessels the company can build is 350 ft., but present plans involve alterations and additions that will enable it to construct vessels ranging to 520 ft. This will involve the entire remodeling of its launching ships and the installation of modern electric traveling crane systems. A large list of general machinery will be required in different departments, but the list of requirements has not yet been completed. Improvements to the company's car building facilities have been extensively made during the past two years.

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Published at the World's Greatest Railway Center
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Standardization of Freight Cars.

E. P. Ripley, president of the Atchison, Topeka & Santa Fe, in an article in the current issue of *The Monthly Official Railway List*, reprinted elsewhere in this issue, calls attention to the imperative need for an absolutely rigid set of standards for all freight cars used in railway interchange. He describes the position of the railway which buys the cheapest cars as warranted from one viewpoint. A cheaply constructed car goes into the pool as the equal of a high-priced car, and the railway which owns it hauls as many of another company's good cars as it does of its own cheaper ones.

The assistance of the law, if necessary, as the means to the end in obtaining standard construction is considered by Mr. Ripley to be desirable. It is, however, much to be preferred that the railways use the necessary foresight to reach an agreement on this matter before being forced to do so by the National Government. For, as Mr. Ripley says, the cumbersome and impractical methods of politicians would make the remedy for the present situation one of greatly lessened value.

The very high standing of the Master Car Builders' Association should make it of great assistance in forming freight car standards, while the organization of the American Railway Association should be able to put an agreement into effect. It would seem that there would be few railways which would hold out if the terms of a standardization agreement were not so drastic as to be a hardship in their execution.

Standardization is sure to come and the railways must soon take the initiative in order that they be not hampered by Federal law.

Superheaters.

The superheater locomotive, first placed in what was then considered heavy passenger service, now superseded by heavier superheaters and relegated to branch line work in both passenger and freight service, is giving the principle of superheating its real test. The small roundhouse in an out of the way district is now caring for the first of the superheater engines to reach the district. It is here, where facilities are limited and technical knowledge is scarce, that the principle is really approved or condemned. It has not been condemned, but on the contrary those in charge of operation, if not also the terminal officers, are pleased with each addition to the division's superheater motive power.

The successful application of the principle to switchers is practically the last step in making superheating universal for all types of power, and there seems now no valid argument, from either the standpoints of operation or maintenance, against its use in all branch line power.

A Good Habit.

The purpose and earnestness of the meetings of the Traveling Engineers' Association was pretty well indicated at its last convention by the fact that from time to time various members would take out their note books and jot down points brought up in the discussion, in which they were particularly interested. It indicated that the organization is in a very healthy state; that it is promoting what an association should promote—the exchange of ideas. Unfortunately such occurrences are the unusual instead of the usual.

It is a good habit to carry a note book and pencil, whether at a convention, on the road or in the shop. Taking down

notes at a convention on points which particularly interest you serves to emphasize them and enables you to follow them up much quicker than would be possible if you waited for the regular proceedings. Taking down notes on the road or in the shop often relieves the mind of a multitude of detail and preserves a record so that action may be taken when there is time to go into the matter. Mental notes are more or less easily erased and one thing crowds after another so fast that it is not surprising that occasionally some important thing is forgotten. Often, too, some new and original idea will pass through the mind, which can be jotted down for further study at a future time.

We were glad to see the note books appear here and there at the Traveling Engineers' convention. We would like to see more of them appear at this and other convention gatherings.

C. I. C. I. & C. F. Convention.

The fourteenth annual convention of the Chief Interchange Car Inspectors and Car Foremen's Association held at Minneapolis on August 26, 27 and 28, proved to be by far the most successful convention yet held by this association and this fact was due in a large measure to the energy of retiring President Stark and his assistants. The attendance was large and nearly seventy new members were placed on the membership list. Another promising fact is that the railroads are encouraging their men to attend and assisting them to obtain the fullest benefit from the meetings.

The sessions of this association are devoted principally to a discussion of the Master Car Builders' rules and are very productive in obtaining a more uniform practice with regard to their interpretation. The questions with regard to car repair and car construction are necessarily brought up in connection with these discussions. It would seem therefore that a number of papers and committee reports covering the latter questions could be worked into the meetings and thus enlarge somewhat the scope of the association. Outside of the Master Car Builders' Association this is the only association devoted primarily to car problems. In the locomotive department there are numerous organizations besides the Master Mechanics' Association, such as the General Foremen, Traveling Engineers, Tool Foremen, Blacksmiths, Boilermakers, etc. The car department has been gaining in importance during the past few years and there is a splendid field of work for the Car Inspectors and Car Foremen's Association, as it is alone among the subsidiary organizations in this field. Its recommendations as to changes in the M. C. B. rules were favorably received during the past year, and if the association will continue to limit its recommendations to the most important changes desired, a great deal of progress will be made.

There is also a very good opportunity to swell the membership by extending invitations to non-members. There are a large number of car men in the country and the membership of the association could be raised close to the thousand mark by systematic work. There is work for this association to do. The discussion of the M. C. B. rules is valuable and it should be supplemented by other subjects prepared by committees. This will give more members a chance to participate in the work of the association and the more members who are called upon to serve in this manner, the greater will be the interest.

Wrecks and Federal Control.

As a result of a recent wreck on the New York, New Haven & Hartford, a movement has been started looking towards Federal control of train operation; and it is stated that a bill will be introduced in Congress at an early date with this end in view. It is said that it will provide for the adoption of an efficient signal system, the immediate replacement of wooden with steel cars, and provision of severe penalities for running trains at a reckless speed. The New Haven system has been particularly unfortunate during the past year or so in the matter of wrecks and whether this has in any measure been due to the past policy of the system cannot be said. It can be said, however, that the man now at the head of that system is one whose ability as a railroad man cannot be questioned.

This proposed piece of legislation is typical of a great deal of the legislation which has added to the burdens of the railways. Some of this legislation it must be admitted has been good, but the majority has been originated with comparatively little study and by men incompetent to go into the questions. With regard to this latest piece of legislation, one of the daily papers stated that "the congressman himself is an authority on railroad operation, as the result of long practice in handling railroad litigation." We are surprised that some of our roads have not sought his services to operate their roads. This man with his extensive experience in litigation will give railroad operation a couple of month's study and then will introduce a bill designed to dictate to the man who has spent years in train operation.

A protest against any such legislation was wired to the congressional committees, and the Interstate Commerce Commission by a large number of railway presidents in which they called attention to the following facts:

> "We fully recognize the right and duty of congress to take any reasonable action that may be adapted to reduce the number of accidents, but we beg respectfully to suggest that the measures being advocated are in some respects too broad and in others too narrow in their scope, and that, therefore, if they were adopted they would not accomplish the beneficent results that congress desires.
>
> "As to steel cars, a recent investigation disclosed that 90 per cent of all the passenger train cars acquired by the railways in 1912 were of all steel and steel underframe construction, and that of those under construction in January, 1913, no less than 97 per cent were of all steel or steel underframe construction.
>
> "The railways, without legislation, are ordering all steel and steel underframe cars faster than the manufacturers can supply them.
>
> "As to block signals, while they are a recognized safety device, the interstate commerce commission showed in its last annual report that out of forty-nine collision accidents investigated by it, forty-eight had been caused by failure of some employe to do his duty, and that of these thirteen had occurred in lines having block signals.
>
> "Steel cars do not prevent accidents; they merely mitigate their effects; and the figures just cited show also that block signals are no specific for collisions. Furthermore, all the legislation proposed deals only with train accidents, and the statistics of the interstate commerce commission show that the fatalities and injuries occurring in train accidents are a relatively small part of the total.
>
> "They show that if there had not been a single

> collision in the fiscal year 1912 no less than 96.5 per cent of all those who were killed on railways would have been killed anyway.
>
> "A clear majority of all the persons killed are trespassers on railway property.
>
> "In view of these facts, we respectfully suggest that any action regarding railway accidents which congress may take should be designed to secure the ascertainment of the causes and the application of the remedies for all classes of accidents."

This communication states the facts clearly. The railways are doing their best to reduce accidents, and they are succeeding, as the records of the Interstate Commerce Commission will show. The most important factor in this work is the man and the biggest work in reducing accidents is being done by the "Safety First" organizations. When every employe has had impressed upon him, his responsibility for others, we will have reduced accidents to a minimum.

As before stated, the railways are installing automatic signals and steel cars as fast as possible, but to ask them to throw away the older equipment and replace it with entirely new equipment at this time would probably throw the majority of our large roads into the hands of receivers. The replacing of all wooden cars by steel cars would cost an immense sum and would be the last straw in the burden which roads are now carrying. Furthermore, it would be impossible for the builders to supply them fast enough and train service would be sadly hampered or suspended. Were our industrial establishments threatened with a law requiring them to throw out all machinery of a certain class and to replace it with new machinery, it would be defeated, while the railroads seem to be the logical prey of the lawmaker. But the people pay in the end; they always pay. Railway employees constitute a goodly percentage of the working population of the country, and it is up to them to get together; to study up on facts and figures so that they may be able to convey to their fellow citizens the true state of affairs. They can point out the cost of complying with such legislation, the decreased earnings of roads, who the owners or stockholders of the railways are, what the "Safety First" movement has been doing, the proportion of trespassers killed to the passengers, and the rate per passenger carried as compared to the European roads, that practically all new equipment is of steel construction, and many other facts which will give the ordinary citizen, and perhaps also the stockholder, a proper view of the matter.

RAILWAY MAIL PAY.

Russell Perkins.

The necessity of meeting constantly increasing expenses, while not being permitted to increase their earnings proportionately, is creating a situation which is becoming decidedly serious for the railroads of the United States. The burdens which have been placed upon the railroads by the Government through laws and regulations, compliance with which requires the expenditure of large amounts of money, are numerous and well known, but one of the greatest injustices to which they are obliged to submit is in connection with a branch of the services with which railroad men as a whole are least familiar, and that is the transportation of the mails.

Agitation of the question of railway mail pay, now going on, invites the query as to what kind of a contract the railroads have with the Postmaster General for the transportation of the United States mails.

Individual firms or corporations entering into an agreement arrange the things each will undertake to do, and make the obligations of each party to the contract appear in signed and accepted form with reasonable understanding.

The Post Office Department, however, when establishing a railroad mail route, demands a company signature to an agreement of which the following is an extract:

"In case the Post Office Department authorizes the transportation of mails over this line, or any part of it, the railroad company agrees to accept and perform the service upon the conditions prescribed by law and the regulations of the Department." If the railroad offers any objection or modification, no voice in what the agreement should be is permitted.

Delay or refusal to sign and accept the agreement results in any enquirer about the establishment of mail service being informed by the Post Office Department that the railroad company will not perform the service, and thus public prejudice is created and pressure is brought to bear to force an agreement.

Every four years the required quadrennial contract or agreement contains the following:

"The company named below agrees to accept and perform mail service upon the conditions prescribed by law and the regulations of the Department applicable to railroad mail service."

Regulations are made from time to time during the period covered by the contract, and are often inconsistent with the law, but nevertheless are construed and enforced as having the force and effect of law and often with great injustice to the railroads, when in fact they are only orders of the Postmaster General. There are many injustices in connection with mail transportation to which the railroads are obliged to submit, but perhaps the worst feature is the fact that contracts for transportation of mails are made to cover four-year periods. The attitude of the Post Office Department toward paying for this service is expressed by the Postmaster General as follows:

"The compensation for carrying the mails is fixed for a four-year period on the basis of the average daily weights ascertained at the last quadrennial weighing on respective mail routes. You are no doubt aware of the fact that such an adjustment both in the practice of the Post Office Department and in contemplation of the law fixing the rates is regarded as full pay for all increases in weights of mails during the contract period for four years after adjustment."

It is a matter of general knowledge that the natural increase in the mails from year to year for a period of four years is considerable, and since the establishment of the Parcels Post it has been abnormal. This is shown by the postoffice records of the principal mail order centers, which have been published from time to time. Notwithstanding the constant increase in mail carried for four years, no additional compensation is paid the railroads, but they are obliged to continue to perform the service for four years for compensation based on the weight of the mail at the beginning of the period.

The rate of pay is low and the railroads should at least be paid for their services on the basis of the amount of mail actually carried. This could be more nearly arrived at by a yearly weighing and contract.

Railroad employees in train and station service who come in direct contact with the handling of mail know that this condition exists, but owing to the isolation of the mail service from the general business of the railroads, a large proportion of the railroad employees do not. It is a matter which is or should be of equal interest to employees of all departments, and they should be interested in having a change brought about, as the amount of revenue to the railroads involved is very large, and more earnings are necessary to assist in obtaining better pay and safer and better working conditions. If railroad men would demand, through those whom they help to place in office, that this injustice be remedied, much good might be accomplished.

Twenty Years Ago This Month

The organization meeting of the Master Blacksmiths' Association was held September 5, 1893. The number of blacksmith foremen who showed interest by attendance or letter was so large as to lend great encouragement to those responsible for calling the meeting. A permanent organization was completed with the following officers: President, J. J. Thornton; first vice-president, Stephen Uren; second vice-president, W. W. McLelland.

September, 1893, was made eventful by the large number of serious accidents occurring on railways terminating in Chicago. No doubt there was intimate relation between the number of accidents and the tremendous volume of the passenger business due to the World's Fair.

The first annual convention of the Traveling Engineers' Association was called at Chicago, September 12, 1893. C. B. Conger, the president, presided at the sessions. The election of officers resulted as follows: President, C. B. Conger; first vice-president, J. A. Goodman; second vice-president, R. D. Davis; treasurer, W. E. Miller; secretary, W. O. Thompson. There were sixty-eight members present.

[Editor's Note.—As noted in the item above, the first president was C. B. Conger. It is interesting to note that the twenty-first convention of this association, as stated in the report published on another page of this issue, voted to set aside sufficient funds to erect a monument in memory of Mr. Conger, who died during the last year.]

A "tug-of-war" between a steam and an electric locomotive was one of the attractions of the World's Fair during the month. As both locomotives were able to slip their wheels the winner naturally was the steam locomotive, as it was the heavier.

The employes of the Cleveland, Cincinnati, Chicago & St. Louis voted to accept a ten per cent reduction in wages on account of the financial depression. A strike had been threatened.

A triple expansion locomotive of very large size was reported to have been built by a Glasgow manufacturer. The drivers were 12 feet in diameter. There were three cylinders of 18 inches, 28 inches and 40 inches diameter, respectively. The stroke was 30 inches and the boiler was the largest in the world.

J. E. Forsyth resigned as general manager of the Hinson Car Coupler & Mfg. Co., to organize the J. E. Forsyth Railway Supply Co., Chicago.

In broad daylight, September 7, 1893, a most remarkable head-on collision between passenger trains on the Pennsylvania Lines West. Fourteen men were killed in the wreck which was due to a lap order, the dispatcher admitting that he forgot.

W. C. Brown, general manager of the K. C., St. J. & C. B. Ry., learned that an attempt to rob one of his passenger trains would be made on September 23, 1893. He made up a dummy train of similar appearance and sent it out of St. Joseph, Mo., on the time of the regular train. It was held up and the robbers were all killed or captured by the guards. The regular train followed forty-five minutes later without incident.

In forty-eight hours ending September 26, 1893, the Pennsylvania carried 15,722 passengers into Chicago.

Col. Geo. W. Goethals has accepted the honorary presidency of the International Engineering Congress and will preside in person over the general sessions to be held in San Francisco, Sept. 20-25, 1915.

The Atchison, Topeka & Santa Fe (coast lines) has awarded a contract for a 25-stall roundhouse to be erected at Los Angeles, Cal., to the Van Sant Houghton Co., San Francisco, Cal.

The Pennsylvania Southern, it is reported, has authorized the expenditure of $200,000 and a large part of this outlay will go for shops at Clarion, Pa.

STANDARDIZATION OF FREIGHT CARS.*

By E. P. Ripley, President, A. T. & S. F. Ry.

(*Copyright, 1913, W. E. Magraw.*)

A few years ago I was returning from the East and encountered on the train a friend who was also in the railroad business. Conversation naturally was on railroad subjects, and I mentioned that I had recently contracted for a lot of freight cars for which I had been obliged to pay nearly $1,400 each. He expressed doubts as to the wisdom of paying so much, stating that he had recently contracted for a car similar at least in outward appearance for about $900. Although perfectly conscious that the difference was simply that which generally exists between the price of a good article and that of a poor one I naturally pursued the subject with the view of ascertaining what could be said in favor of the cheap construction of box cars. I found that my friend being strictly limited as to available cash—having many needs and little money—considered *units* as of more consequence than quality; that having, for instance, a million available dollars he would prefer to buy with it 1,100 cheap cars rather than 715 good ones. He did not deny that the cheap car would be in the long run more costly by reason of continual repairs, but believed that present use of more units was of more consequence to him individually than a cheapening of maintenance costs through a series of years. And, moreover, he called my attention to the fact that in practice a "car was a car," and that his cheap car would earn just as much on other roads as mine would. He admitted that when we gave him a good car in return for a cheap one he got the best of the bargain and that when we put one of his cheap cars in one of our trains we took chances of accident by reason of their weak construction; the danger of broken wheels or axles, of weak draft rigging and broken sills are a menace to the safety of *our* trains.

All this led me to consider the matter of car construction seriously, and the more I think of it the more it seems to me that freight car construction should be upon certain standards and uniform on all roads in the United States—even if it is necessary to resort to law in order to get uniformity. Not only would this result in a probability that a "foreign" car would be in fit condition to be loaded and run (which is now very doubtful); not only would danger from cheap and inherently weak cars be eliminated, but all parts would be interchangeable and great savings would ultimately be made by no longer having to carry in stock certain items of special equipment used in conformity with the prejudices and idiosyncrasies of the carbuilders, or other officers of any one road and condemned by all others.

I suggest a standard car uniform in all essential details to be arrived at by agreement, if possible—arbitration if necessary. If in addition we could establish a freight car pool, or an equipment company, the stock of which should all be owned by the railroads, so much the better. There is no sort of doubt that we shall be forced to something of this kind eventually. Why not make the attempt to do it voluntarily and properly instead of being obliged to do it by law with the necessary accompaniment of federal inspectors and the cumbersome and often impracticable notions of the particular politicians who happen to be making laws for us at the time.

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*From The Monthly Official Railway List.

Jeffery Shops of the Western Pacific.

By W. E. Johnston, Chief Draftsman.

At the time regular operation of the Western Pacific Railway was begun in 1910, all of the equipment, except a small amount used in construction, was new. The repairs to locomotives were therefore light and could be handled reasonably well at the various roundhouses. Anticipating the necessity for more elaborate shop equipment as the rolling stock became older, the company began construction nearly two years ago and has now completed its new plant, known as the Jeffery Shops, in Sacramento, Cal.

The history of practically all railroad shops has been one of gradual growth, and many times insufficient space has been allowed both as to the shop grounds as a whole and between the various buildings to which extensions have become necessary. In laying out the general plan of these shops, the probability of future growth has been kept in mind and ample provision has been made for a very large increase; in fact, the shop was laid out as a large plant and a portion only has now been constructed.

A plat of the shop layout is reproduced herewith. The buildings shown in solid lines are those which have now been erected. Future extensions and future buildings are shown in dotted lines. Tracks serving the various buildings are arranged to enter the shop grounds from both ends to facilitate switching. No turntable has been provided as there is a "Y" on the main line near the shop site on which locomotives from the eastern terminals are turned so as to head into the erecting shop.

Machine and Erecting Shop.

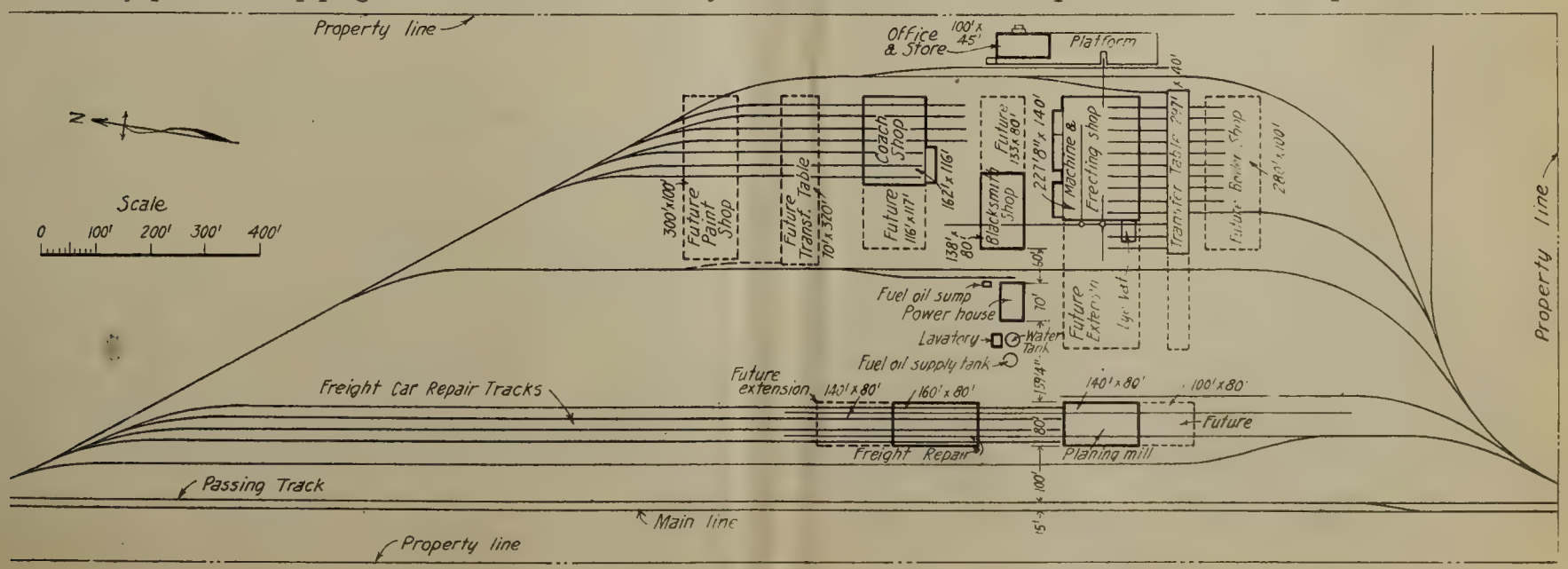
This is the largest of the buildings and is 140′ wide by 227′8″ long and contains ten pits. Provision has been made for extension to 445′ long to contain twenty pits. As shown by the plan and section of the building reproduced herewith, it has one main bay in which the erecting pits and the heavier machine tools are located and a side bay for the lighter tools. The building is of steel with reinforced concrete walls except the end toward the future extension which is of wood. The arrangement of the sawtooth roof over the side bay and the large windows in the main bay give exceptionally good illumination. The sash in the upper windows of the main bay and the sawtooth roof of the side bay are controlled from the floor by sash operating devices giving sufficient natural ventilation. Owing to the mild climate, very little artificial heat is necessary and small direct steam radiators between atlernate pits on the erecting side and three similar ones on the machine side are considered sufficient. Connections have been provided at each pit for air, steam and water, the mains for all being carried under the floor in a duct which has removable covers so that any part of the piping can be reached conveniently.

The main bay is served by a Shaw 120-ton six-motor electric traveling crane which has two main hoists of 60 tons capacity each and one auxiliary hoist of ten tons capacity. The speed of the main hoists is eight feet per minute, of the auxiliary hoist twenty-four feet per minute and of the bridge travel 200 feet per minute. This speed of bridge travel, while higher than usual for such a heavy crane, has proved entirely satisfactory and adds materially to its usefulness on light work. The span of the crane from center to center of runway rails is seventy-four feet six inches. Alternating current motors of the wound rotor or slip ring type are used throughout the crane and have given entire satisfaction. In the side bay the roof has been placed at a sufficient height so that a traveling crane can be installed when considered advisable. At present machines on which heavy pieces are handled are provided with individual jib cranes of capacities as required.

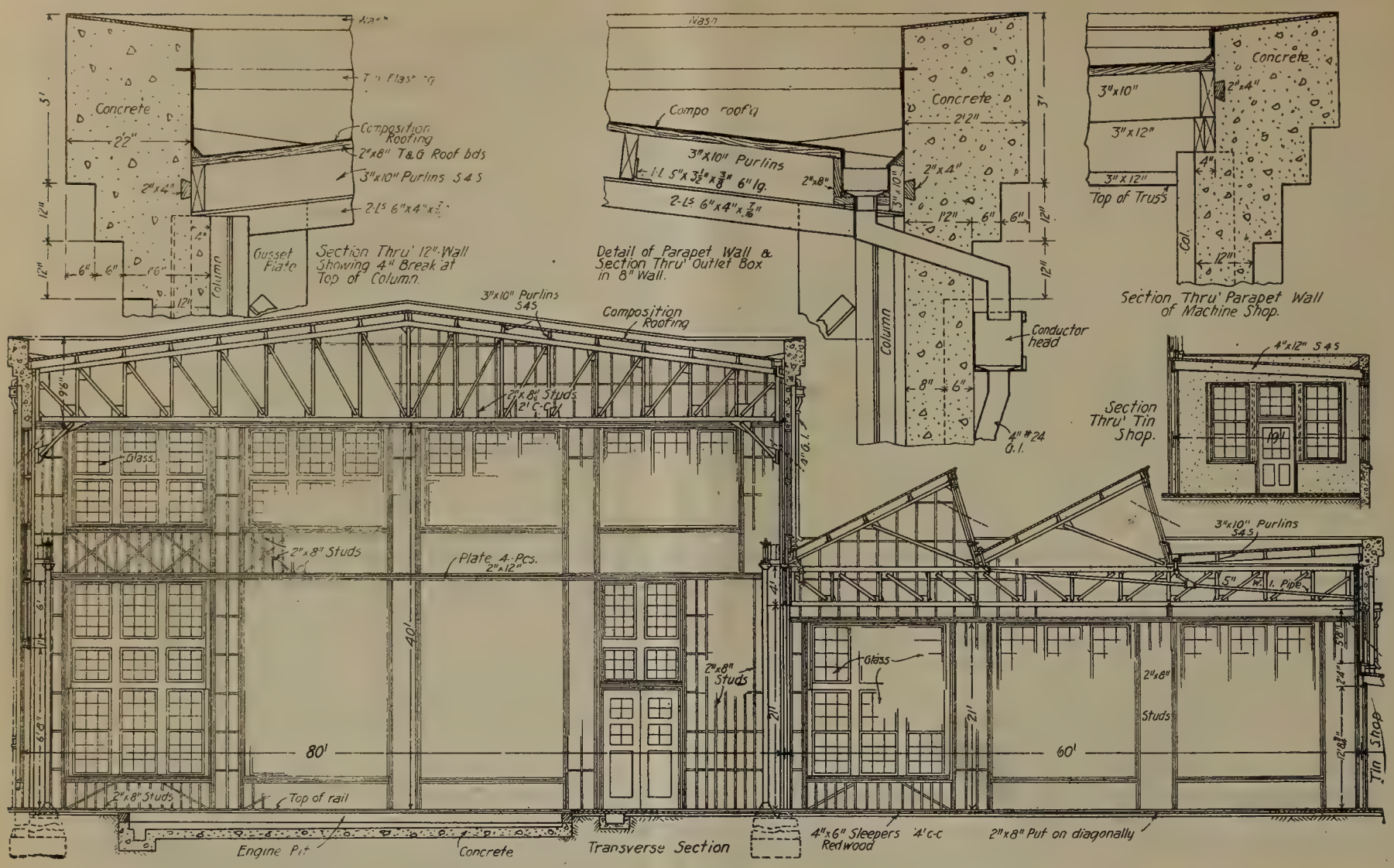
The machinery is located as shown in the drawing, that in the main bay being located so as to be served by the auxiliary hoist on the 120-ton crane and that in the side bay on each

Machine and Erecting Shop from Southeast

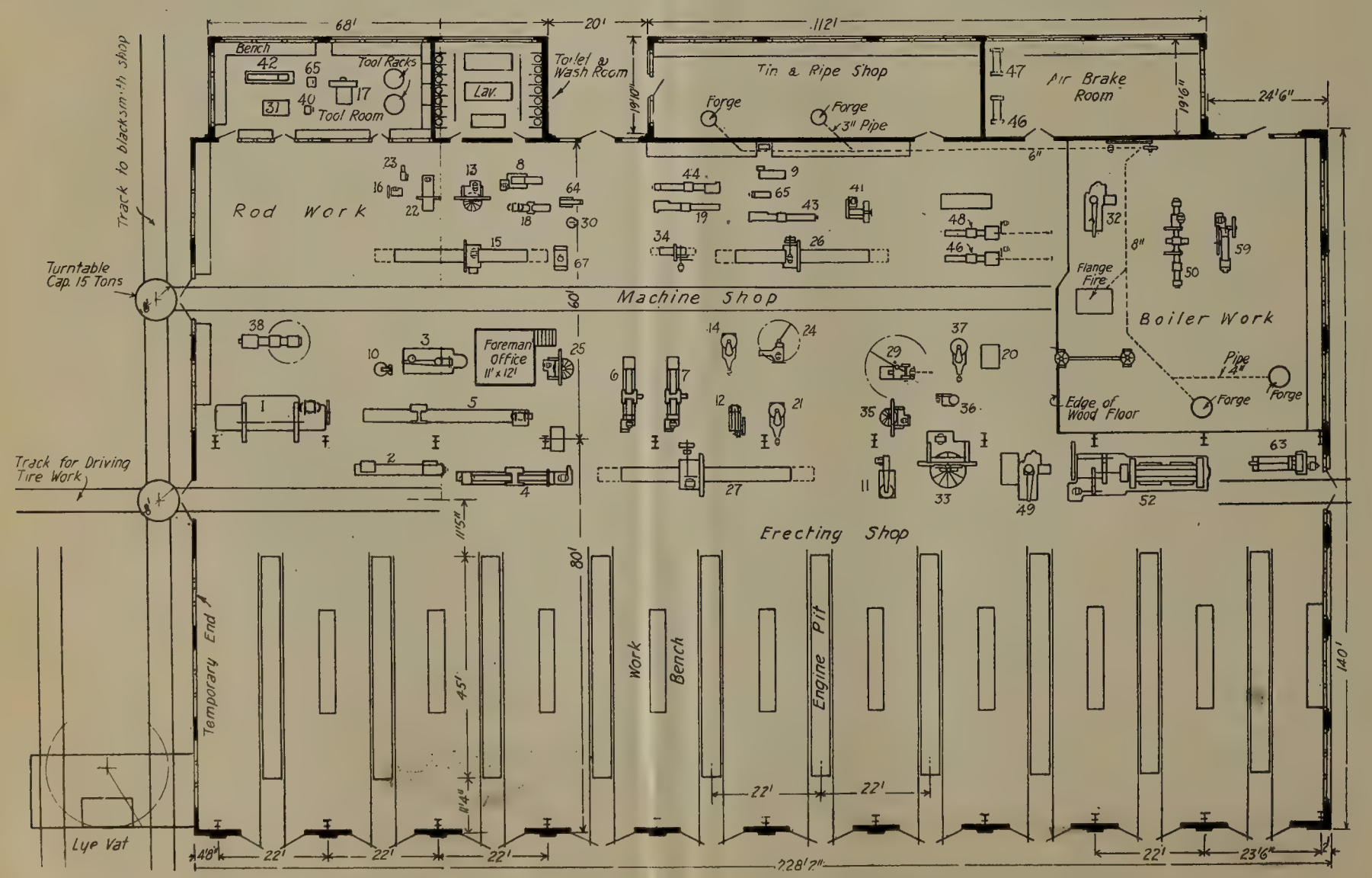
side of a track running lengthwise of the shop and onto a turntable at the end. This turntable, as shown on the plan, is also in the track extending from the transfer table past the end of the machine shop and into the blacksmith shop. The lye vat is also located by the side of this latter track between the transfer table and the tracks leading into the machine shop. The vat is served by a pneumatic jib crane reaching over this tank and also over another leading off from the transfer table as shown. The object of this arrangement is to concentrate the cleaning of all greasy parts at a point on the natural line of motion from the pits on which the stripping is done to the machine shop and blacksmith shop. The method of



Layout of the Jeffery Shops of the Western Pacific Near Sacramento, Cal.



Section of Machine and Erecting Shop, Jeffery Shops.



Plan of Machine and Erecting Shop. See List of Machine Tools for Tools Corresponding to Numbers Shown Above.

operation, in the case of driving boxes, for example, is to lift the locomotive with the crane, roll the wheels with the boxes in place out from under and onto the transfer table which brings them to the track past the lye vat. As the wheels pass the vat, the boxes are dropped off and put into the vat and the wheels are cleaned and passed along to the turntable leading into the main bay to the wheel lathe and wheel press, or if new tires are required they are run out in the opposite direction onto the stub track provided for this purpose. Driving springs, saddles, pedestal binders, etc., are loaded onto push cars at the rear end of the locomotives after the wheels are removed and are taken to the lye vat and cleaned and then passed on to the machine or blacksmith shop as required.

The adoption of individual motor drives for all the machinery simplified the arrangement greatly, making it possible to locate every machine in its most convenient location and eliminating all shafting and belting. Most of the motors are of the constant speed type, speed changes being secured through gear boxes. For several old tools, which were originally belt driven, multi-speed motors of the constant horsepower type having synchronous speeds of 1800, 1200, 900 and 600 R. P. M. have been used. The different speeds on these motors are obtained by changing the number of poles in the stator windings by means of drum controllers.

Blacksmith Shop.

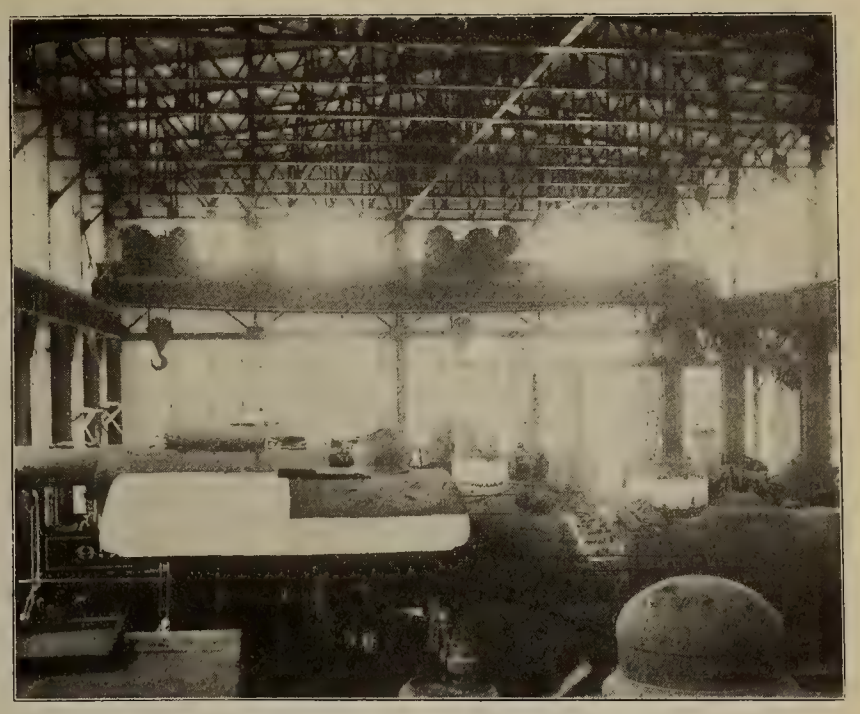
This building is 81′-0″ wide by 138′-0″ long, of steel with reenforced concrete walls similar to the machine and erecting

Blacksmith Shop.

shop. The height of 22′-3″ to the roof trusses and 27′-6″ to the roof proper give a light airy shop free from gases without the use of elaborate smoke removing appliances. As in the machine shop, all the power driven machinery is individually driven by electric motors. This has been found especially advantageous as it has permitted ample spacing between machines and the location of any machine in the exact position desired.

In the case of the Bradley hammer, the usual overhead drive was not desired and a novel and original motor drive was designed with the motor on the floor at the side of the hammer. Blast for the forges and furnaces is furnished by a No. 10 Sturtevant steel pressure blower driven by a 50 H. P. motor. Vitrified sewer pipe is used for the blast piping, ample branches being provided to take care of future connections without breaking into the main duct. Oil furnaces are used for the bulldozer, the Bradley hammer, bolt header, 3300 pound hammer and for the spring work. For handling heavy work to the steam hammers, jib cranes of the usual type are used, the larger being ball bearing to give easy motion and avoid delay on the way from the fire to the hammer.

In order to simplify the oil and blast piping to the flue furnace, the flue work is also done in one corner of this shop. The track past the end of the machine shop previously referred to makes this location very convenient.



Interior of Main Bay of Machine Shop.

Power House.

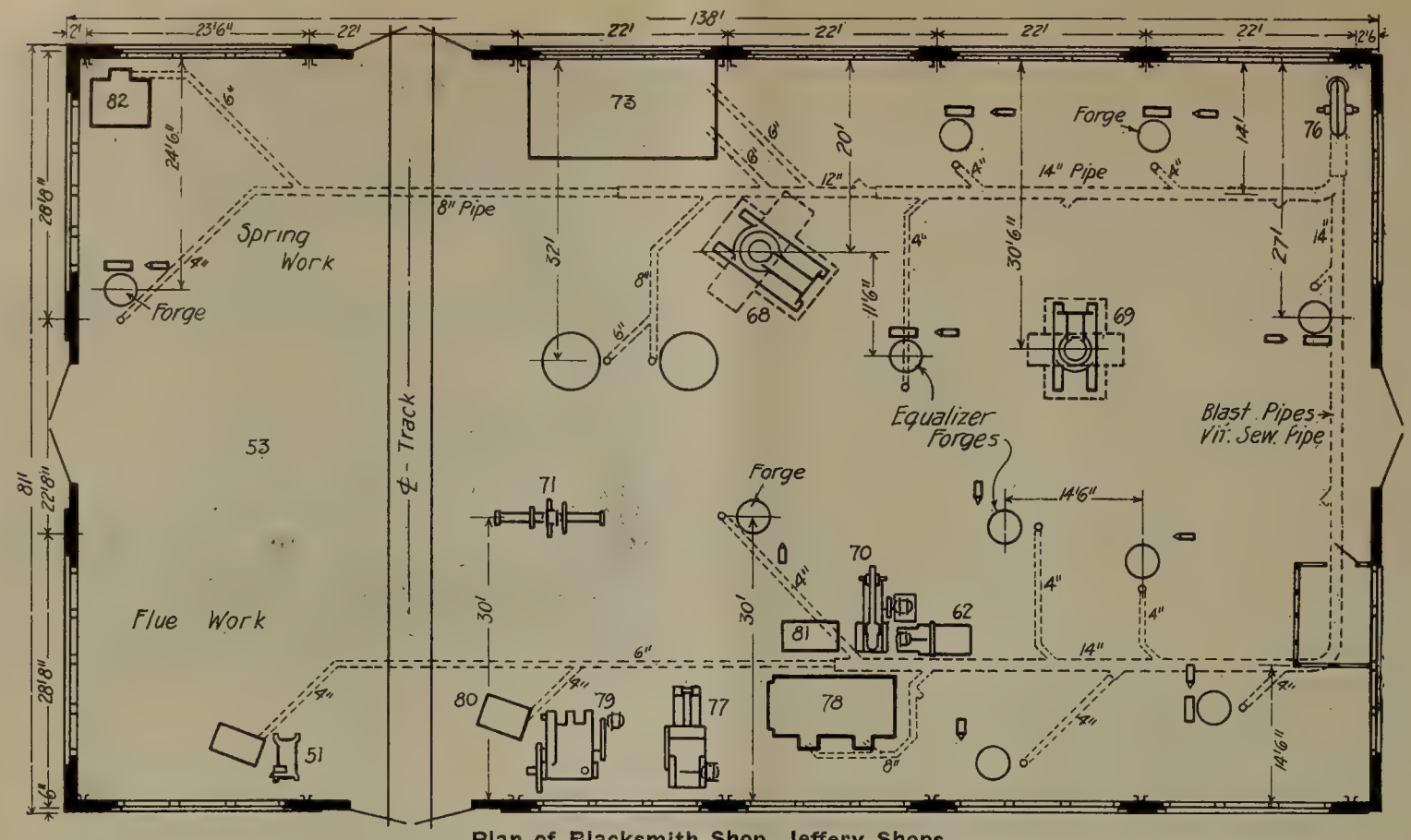
The purchase of electric current from an outside concern, and the fact that there are competing concerns capable of furnishing the current from water power plants has made an electric generating plant unnecessary. Steam for the steam hammers, for the operation of pumps and a small amount occasionally for heating in the winter months is all that is required and this is furnished by two 125 H. P. oil burning Scotch marine boilers. A reenforced concrete chimney, 48″ by 80′-0″, which has sufficient capacity to handle four 125 H. P. boilers has been erected in preference to either a self-supporting steel or brick stack on account of its lower first cost and greater durability. The two Underwriter pumps for fire protection and boiler washing have a capacity of 500 gals. per minute each, which is sufficient for four good fire streams. The cooling water from the air compressor and the water cooled transformers is run into an open feed water heater, which serves three purposes in saving this water with the heat there is in it, heating all the feed water to a high temperature and removing the encrusting solids.

Compressed air is furnished by a 1050 ft. two stage belted air compressor driven by a 200 H. P. 2200 volt constant speed motor. Variations in the consumption of air are taken care of by a choking unloader on the compressor.

Passenger Car Shop.

This shop is of steel with reenforced concrete walls, the same as for the machine and erecting shop. It has no machinery, as the company's passenger equipment is all of steel, and repairs, except in the case of wrecks, consist only of work on the trucks, which is small in quantity and is handled on the loco-

Passenger Car Shop.

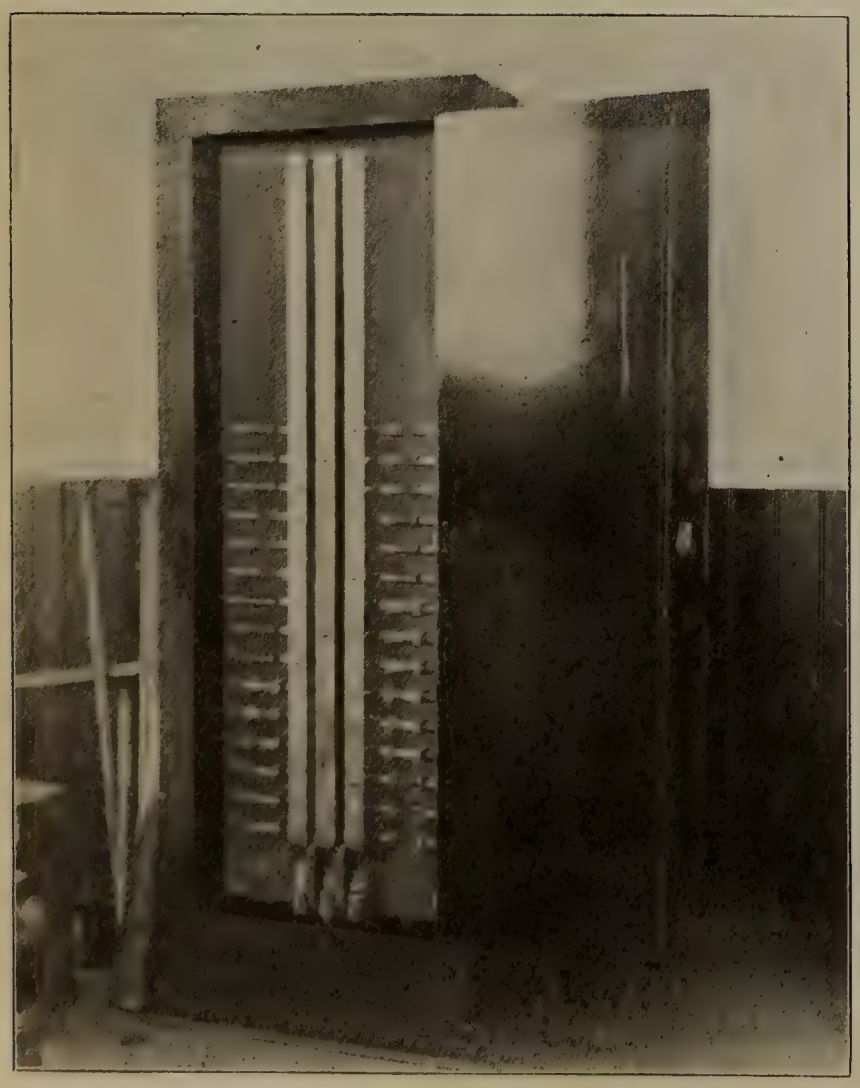


Plan of Blacksmith Shop, Jeffery Shops.

motive side for the present, the usual painting and varnishing and the necessary work on the interior furnishings, which is also light.

Planing Mill.

This building is of wooden frame construction covered with corrugated iron. Tracks connected to the yard system run into one end of the building so that cars loaded with lumber can be brought directly to the machines, and so that shop order work for outside points can be loaded direct from the machines onto the cars. At the opposite end of the building, industrial tracks are provided, leading into the repair yard for handling lumber direct to damaged cars.



Distributing Panel in Machine Shop.

A shavings exhaust system is used to collect the shavings from the various machines and deliver them to a car on a siding near the mill. The exhauster is of the slow speed type and has a 60" wheel mounted directly on the shaft of a 50 H. P. motor running at a speed of 850 R. P. M. All of the machinery is individually driven by electric motors, giving entire freedom in the location of tools for the most economical handling of material.

Electrical Distribution.

A system of electrical distribution much more elaborate than that usually found in railroad shops was made necessary by the large number of motors required with the system of individual drives. Current is purchased from the Great Western Power Co., which has a large hydro-electric in the Feather River Canon on the line of the railway. The potential at the entrance to the shop site is 22,000 volts, which is stepped down to 2,200 volts by the power company's transformers.

General distribution to motors is at 220 volts and to lights at 110 volts. These voltages were originally adopted by the company in order to reduce the possibility of injury to workmen to a minimum and have been adhered to in this installation for this purpose as well as to maintain a standard over the line. The only exception is the 2200 volt air compressor motor, which is handled by an experienced operator and which is not in a place open to other employes. Even with this voltage the danger to the operator is infinitesimal as the wiring is fully enclosed and the framework of the motor and the case of the compensator are thoroughly grounded.

The transformer house, located just west of the machine and erecting shop, is the center of distribution for the entire plant. As this is very close to the center of load of the machine shop and the blacksmith shop, the 2200-220 volt transformers for power and the 2200-110 volt transformers for light for these buildings are located in it. For the mill the extra cost of separate transformers was less than that of the heavy copper that would have been necessary for distribution at 220 and 110 volts and the power and light for this building is, therefore, supplied by transformers located near it to which current is supplied from the transformer house at 2200 volts.

Distribution between buildings is entirely in lead covered varnished cambric insulated cables in fibre conduit laid in a concrete envelope underground. There is, therefore, an entire absence of the usual unsightly pole lines. Distribution inside

of buildings is entirely in galvanized metal conduit, separate circuits being provided for the distributing panels to each machine. The distributing panels are enclosed in steel cabinets, which are large enough to allow wiring spaces at the sides and back of the panels, thus allowing the wiring in the cabinets to be run back of the panels, although the connections to the fuses are all on the face of the panels so as to be reached conveniently. Conduits containing the mains and branches are brought into either the top or bottom of the cabinets as circumstances require, and are provided with lock nuts and bushings similar to the practice with steel cabinets for lighting panels.

Motors of 7½ H. P. and above are provided with compensators with low voltage release attachments. Motors under 7½ H. P. are started with double throw switches, so arranged that they can not be left in the starting position. In the case of motors which are more than usually liable to overloads, overload relays are used. These act on the low voltage release on the compensators and eliminate fuse renewals as well as the delay incident to the replacement of fuses.

On the main switchboards in the transformer house, automatic oil switches are used on 2200 volt circuits and automatic air brake circuit breakers with carbon auxiliary contacts on 220 volt circuits. Where required, these oil switches and circuit breakers are equipped with inverse time limit relays to avoid excessive sensitiveness to momentary overloads.

The design and construction of the buildings was handled by W. H. Mohr, architect, under the supervision of T. J. Wyche, chief engineer. Mechanical and electrical details were handled by W. E. Johnston, chief draftsman, under the supervision of J. E. O'Brien, superintendent of motive power.

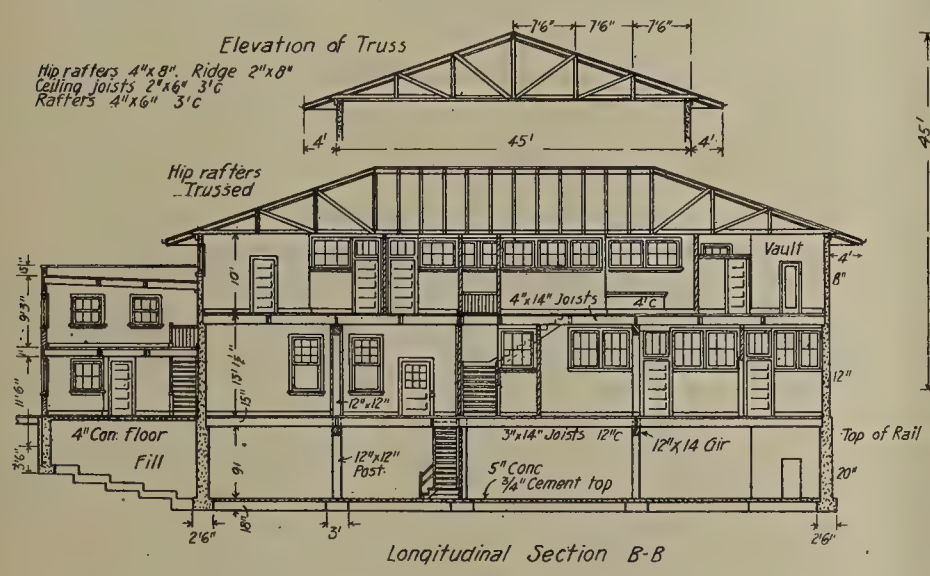
The tools and machinery installed in the new shops are as follows. All machines are motor driven, except where otherwise stated. The numbers indicate the location of the machines in the plan drawings:

Machine Shop.

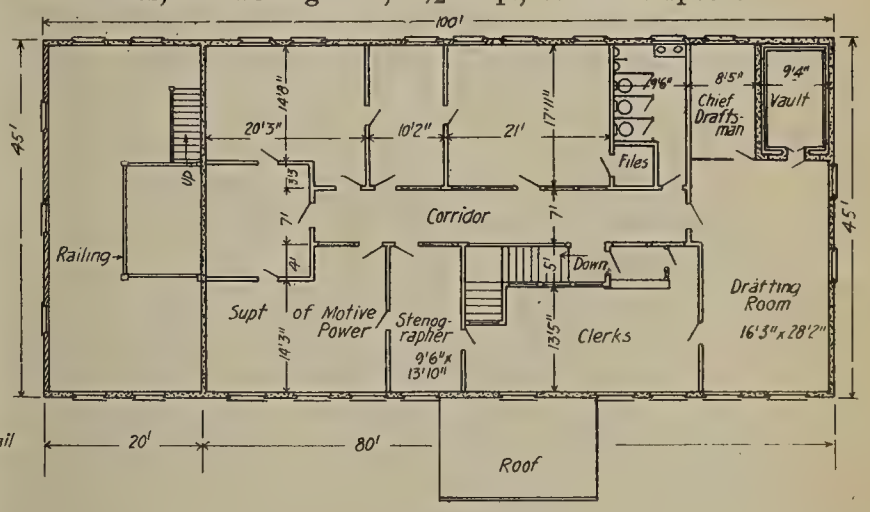
1—Putnam, 90" wheel lathe, 35 h. p., constant speed (belted).
2—Niles, 400 T 84" wheel press, 10 h. p., constant speed.
3—Baush, 92" radial drill, 6 h. p., multi-speed.
4—Pond, 42"x22' engine lathe, 15 h. p., multi-speed.
5—Bement-Miles, 36"x26' engine lathe, 6 h. p., multi-speed.
6—Lodge & Shipley, 27"x14' engine lathe, 7½ h. p., constant speed.
7—Lodge & Shipley 27"x14' engine lathe, 7½ h. p., constant speed.

Office and Store, Jeffery Shops.

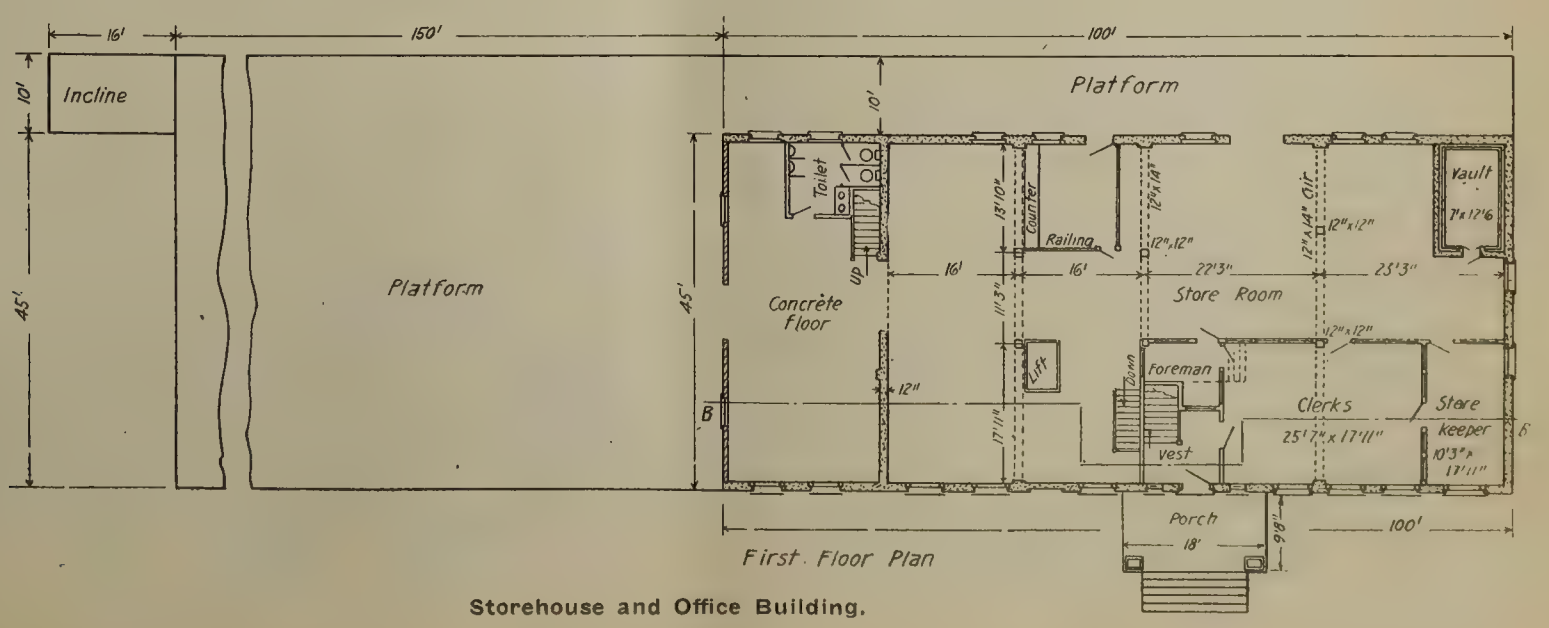
8—Acme, 3" single bolt cutter, 3 h. p., constant speed.
9—Williams 6" pipe machine, 3 h. p., constant speed.
10—Ransom, 24"x3" single water emery grinder, 3 h. p., constant speed.
11—Bement, 15" slotter, 5 h. p., constant speed.
12—Smith & Mills, 25" back geared crank shaper, 5 h. p., constant speed.
13—Niles, 42" boring mill, 7½ h. p., constant speed.



Longitudinal Section B-B

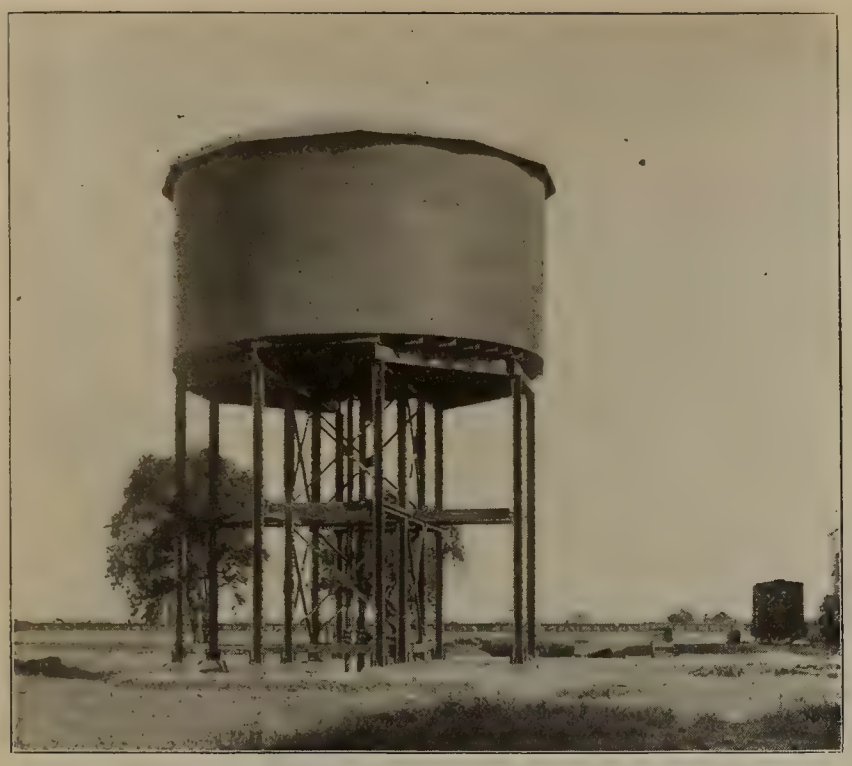


Second Floor Plan



First Floor Plan

Storehouse and Office Building.



75,000-Gallon Fuel Oil Supply Tank.

14—Cincinnati-Bickford, 42″ drill press, 5 h. p., constant speed.

15—Pond, 56″x36″x16′ planer, 7½ h. p., constant speed.

16—Watson-Stillman, 30 ton hydraulic rod bushing press, 3 h. p., constant speed.

17—Le Blond, No. 3 universal milling machine, 5 h. p., constant speed.

18—Le Blond, 18″x8′ engine lathe, 4 h. p., multi-speed.

19—Lodge & Shipley, 20″x12′ lathe, 5 h. p., constant speed.

20—Bickford, 26″ drill press, 3 h. p., constant speed.

21—Cincinnati-Bickford, 42″ drill press, 5 h. p., constant speed.

22—Morton, 30″ draw cut shaper, 7½ h. p., variable speed.

23—Q. & C., No. 4 power hack saw, ½ h. p., constant speed.

24—Watson-Stillman, 60 ton hyraulic press, 3 h. p., constant speed.

25—Niles, 42″ boring mill, 7½ h. p., constant speed.

26—Pond, 36″x36″x15′ planer, 7½ h. p., constant speed.

27—Pond, 48″x48″x20′ planer, 15 h. p., constant speed for drive, 2 h. p., constant speed for rail.

28—

29—Morton, 32″ special, railroad shaper, 10 h. p., variable speed.

30—Cincinnati, 14″ sensitive drill, ½ h. p., constant speed.

31—Sibley & Ware, 20″ drill press, tool room group (belted).

32—Cincinnati-Bickford, 60″ plain radial drill, 5 h. p., constant speed.

33—Niles, 84″ boring mill, 15 h. p., constant for drive, 3 h. p., constant for rail.

34—Bement, 20″x20″x24″ crank planer, 4 h. p., multi-speed.

35—Miles, 42″ boring mill, 7½ h. p., constant speed.

36—Diamond, No. 2 single water tool grinder, 3 h. p., constant speed.

37—Cincinnati-Bickford, 42″ drill press, 5 h. p., constant speed.

39—Gisholt, 28″ turret lathe, 5 h. p., constant speed.

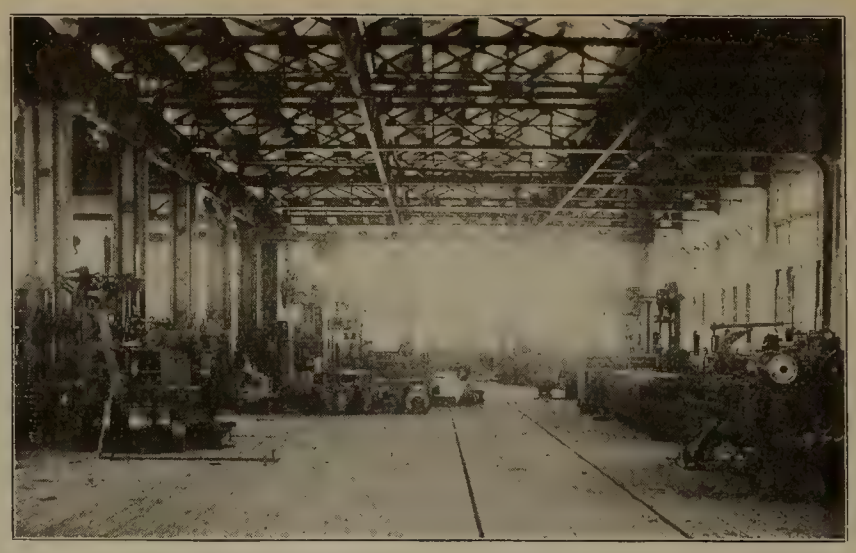
40—Wilmarth & Morman, style A twist drill grinder, tool room group (belted).

41—Cincinnati, No. 3 universal milling machine, 7½ h. p., constant speed.

42—Pratt & Whitney, 16″x8′ tool room lathe, tool room group (belted).

43—Lodge & Shipley, 18″x12′ engine lathe, 5 h. p., constant speed.

44—Lodge & Shipley, 20″x12′ engine lathe, 5 h. p., constant speed.



Interior of Side Bay of Machine Shop.

45—Bardons & Oliver, 15″ brass lathe, brass room group (belted).

46—Jones & Lamson, 3″x36″ turret lathe, 5 h. p., constant speed.

47—Acme-Cincinnati, 18″ brass lathe, brass room group (belted).

48—Jones & Lamson, 3″x36″ turret lathe, 5 h. p., constant speed.

49—Cincinnati-Bickford, 60″ universal radial drill, 5 h. p., constant speed.

64—Putnam, nut facing machine, 1¾ h. p., multi-speed.

65—Pratt & Whitney, 4″ centering machine, ½ h. p., constant speed.

66—Cincinnati, universal cutter grinder, tool room group (belted).

67—Ransom, 24″x4″ double dry grinder, 5 h. p., constant speed.

Underwood, 30″ valve facing machine, air motor driven.

Portable, cylinder boring bar, 5 h. p., constant speed.

Boiler Shop.

50—Hilles & Jones, No. 5 double punch and shear, 15 h. p., constant speed.

51—Hartz, flue welding machine, 5 h. p., constant speed.

52—Fulton Eng. & S. B. Works, 12′ plate bending rolls, 20 h. p., variable speed.

53—W. P., flue cutter, 5 h. p., constant speed.

54—W. P., flue rattler, 25 h. p., constant speed.

55—W. P., forge.

56—W. P., forge.

57—W. P., flange blocks.

58—W. P., flange fire.

59—Hilles & Jones, No. 3 horizontal punch, 7½ h. p., constant speed.

60—Sturtevant, No. 3 steel pressure blower, 5 h. p., constant speed.

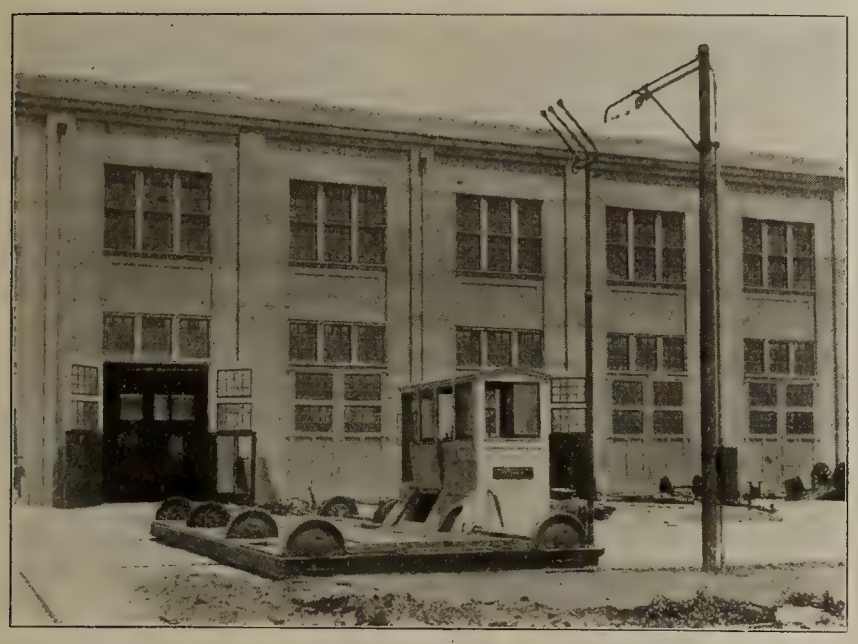
61—Niles, 12′ flanging clamps.

63—Niles, 6′ plate bending roll, 10 h. p., variable speed.

Mill With Freight Car Shed in Distance.

Blacksmith Shop.

62—Acme, 2″ stay bolt cutter, 2 h. p., constant speed.
68—Bement, 3300-lb. single frame steam hammer.
69—Bement, 1100-lb single frame steam hammer.
70—Bradley, 200-lb. cushioned helve hammer, 10 h. p., constant speed.
71—Long & Allstatter, No. 2 double punch and shear, 7½ h. p., constant speed.
72—Cleveland, grindstone, 1 h. p., constant speed.
73—Scrap furnace.
74—10 forges.
75—12 anvils.
70—Sturtevant, blower No. 10 pressure, 50 h. p., constant speed.
77—Williams, White & Co., No. 4 bulldozer, 7½ h. p., constant speed.
78—Bulldozer furnace.



"Low-Down" Transfer Table.

79—Acme, 2″ forging machine, 15 h. p., constant speed.
80—Forging machine furnace.
81—Bradley hammer furnace.

Planing Mill.

Berlin, 20″x14″ sizer, 50 h. p., slip ring.
Berlin, 30″x6″ matcher, 50 h. p., slip ring.
Greenlee, No. 502P car gainer, 15 h. p., constant speed.
Fay & Egan, No. 3 cut-off saw, 15 h. p., constant speed.
Fay & Egan, No. 3 self-feed rip saw, 15 h. p., constant speed.
Fay & Egan, No. 163-5 spindle car borer, 15 h. p., constant speed.
Fay & Egan, No. 350 hollow chisel mortiser, 20 h. p., constant speed.
Fay & Egan, No. 50—36″ band saw, 5 h. p., constant speed.
Greenlee, No. 551 hand planer and jointer, 5 h. p., constant speed.
Berlin, No. 201 two spindle shaper, 7½ h. p., constant speed.
Atlantic, 30″x12′ pattern makers lathe, 7½ h. p., constant speed.
Bridgeport, 32″ planer knife grinder, 5 h. p., constant speed.

Power House.

Murray Iron Works, 2-125 h. p., Scotch marine boilers.
Hoppes, 300 h. p., open feed water heater.
Worthington, 2-14″x7¼″x12″ Underwriter pumps.
Worthington, 1-7½″x6″x10″ duplex oil service pump.
Worthington, 2-6″x4″x6″ duplex boiler feed pump.
Worthington, 1-4½″x2¾″x4″ double fuel oil set.
Ingersoll-Rand, 22″ and 13″x16″ two stage air compressor with 200 h. p. constant speed motor.

GASOLINE FREIGHT AND SWITCHING LOCOMOTIVE.

A gasoline freight and switching locomotive has recently been built and delivered by the McKeen Motor Car Co. to the Minneapolis & Northern Railway, a line extending from Minneapolis northwest to Anoka, Minnesota. This locomotive, which is illustrated herewith, has a maximum capacity of approximately 20 freight cars.

The power generating apparatus is the McKeen standard 200 horse power, six-cylinder, air starting and reversible gasoline engine, which propels the McKeen passenger motor car, with such modifications in the transmission as are necessary to adapt it to heavy duty freight service. All the latest improvements, such as enclosed crank case, enclosed herringbone gears, new clutch, etc., are embodied in the locomotive.

The engine is water cooled, the cooling system consisting of two radiators located on the cab roof, and a gear pump driven from engine crank shaft by 1½″ .9 pitch Morse chain.

The cast steel skirk which carries the engine is mounted transversely upon the two cast steel unit side truck frames, to which it is so rigidly united as to produce practically an indestructible truck structure. The end sills or buffer beams are secured to the side frames and all couplings and air apparatus is M. C. B. standard material.

The power of the engine is, by means of a sprocket on the crankshaft through a 5″ Morse silent chain, transferred to a sleeve working free on the axle. Here the power is transferred (control operated by air cylinders) through a multiple disc friction clutch. This friction clutch is of heavy design and large dimensions with suitable lubrication, and acts as a means to ease the load on the engine. The power from the friction clutch is delivered to the forward driving axle by an octoroon clutch (operated by air cylinders). The power is either magnified by a series of gears to produce heavy tractive effort and high torque for starting purposes, or is transferred direct to the driving wheels. By thus magnifying the torque of the internal combustion engine, great starting effort is obtained for this style of locomotive. At the same time the locomotive once in motion, the higher economy can be obtained by cutting out the gears and obtaining the direct connection. A sprocket is keyed to each driving axle end for a 4″ Morse silent chain which connects the two pairs of drivers.

The retarding of the speed of a passenger or freight train is accomplished by the application of brake shoes to the periphery of revolving wheels; conversely, it is easily seen, that the application of suitable friction shoes to the periphery of a driving mechanism will accelerate the train with equal facility. The ordinary switch locomotive in retarding the speed on a given number of cars has, with its tank brakes and driver brakes combined, a brake shoe-bearing surface area of 810 square inches. For starting a train, a friction clutch area of 2200 square inches is 2.71 times greater than the said surface of the switch engine, which will unquestionably furnish a large margin of safety to the handling of this sort of service.

On the steam locomotive the distribution of the weight on the different drivers does not always attain the highest economy, whereas, through the design of this internal combustion locomotive, all weight carried is utilized to its maximum possibilities without in any way interferring with the economy and operation of the internal combustion engine mechanism.

In handling of the friction clutch, the change of speeds is made by means of air-actuated mechanism, controlled by handles or levers located in easy reach of the operator. The handling, by means of these small levers, affords considerable facility to the motorman in switching in congested yards, over that of an ordinary steam locomotive.

The operator, relieved from all fatigue incident to the handling of links, valve mechanism of a locomotive, through a reverse lever, handling of the throttle lever, etc., will have more energy to give to the handling of the locomotive in his

McKeen Gasoline Switching Locomotive, Minnesota & Northern Railway.

charge, and we believe the work done by this additional conserved energy of the operator will add materially to the economy of this style of locomotive. The conservation of energy and the saving of labor to the manipulator—thereby preserving the highest efficiency of the operator—gives considerable impetus to the efficiency of the internal combustion engine in its regular every-day service. The fact that the motorman does not have to remove his eyes from the track, and can operate the locomotive in his charge by small levers, with practically no physical fatigue or undue effort whatsoever, considerably increases the safety and facility of switching in congested yards.

The operator's seat is located at one end of the locomotive and gives an unobstructed view in one direction and a view in the other much better than that of an ordinary steam locomotive. The reversing of the locomotive is controlled by a small lever located on the side of the cab, somewhat analagous to the reverse lever of a steam locomotive. This lever is of small dimensions and is simply a control lever for operating the air cylinders which actuate the engine proper. Its accessibility and extreme facility of operation is particularly meritorious from an every-day operating standpoint. The transmission is controlled by a small 8-in. lever located at the left of the operator's seat. This lever operates the mechanism through a system of air cylinders and requires a minimum expenditure of muscular effort. In easy reach is the throttle for the control of the engine proper, the brake valve for stopping the locomotive, and the ordinary bell and whistle signals.

A 5" bore by 4" stroke air pump is connected to the engine skirk and is driven by an eccentric on the crank shaft.

The air supply of the locomotive being a necessary one and important; in addition to an air pump driven by the main engine, a gasoline power air-compressor is furnished entirely separate from the locomotive power. This is not only economical, but simplifies and insures the driving mechanism for the switching service. Air pressure is used for actuating the engine and transmission, control of the whistle signals, for the brakes, for starting and reversing the engine, and while the consumption of air is reasonable, the quickness and ease of control and management of the switching locomotive are materially improved and expedited thereby.

Simply to insure the reliable performance of the locomotive and to protect any possible contingencies, the auxiliary air compressor of special design is provided. If there is any loss of the air pressure from any particular cause, any accident to the air pump or a case of negligence where the air pressure is lost, this auxiliary air compressor, which has its own power cylinder and is a particularly high duty machine, can pump up the necessary air pressure in from five to ten minutes. This auxiliary compressor is not supposed to be used except for emergencies and to prevent interruption of the locomotive service.

The cylinders, vapor pipes, carbureter, ignition devices, etc., properly housed in and sheltered from the elements and dust, by the cab of a locomotive, are not only protected from damage and possible failure, but are rendered accessible to the operator; he is kept in intimate touch with the performance of the mechanism; and repairs can be made at a minimum cost and under favorable conditions.

The exhaust from the engine is carried up through a muffler and out through the ordinary stack in the roof of the cab. The gasoline tank is of 120 gallons capacity, or fuel for at least over ten hours ordinary service. This tank, however, could be enlarged to suit the local conditions, which would be entirely dependent upon the accessibility to the gasoline supply.

Details of construction follow:

Engine—6 cyl., 10" bore, 12" stroke, variable speed, reversible, 200 horse power.

Transmission — High speed, direct; low speed reduction through herringbone gears; clutch, multiple disc; drive engine to clutch 5"—2" pitch Morse chain; front to rear drivers, two 4"—1½" pitch Morse chains.

Gauge, 4' 8½"; Length of wheel base, 6' 6"; Length over pulling face of couplers, 17' 1½"; Width over all 9' 6"; Diameter drivers, 42"; Weight on drivers, 43,000 lbs.; Speed, low 8 M P H with engine at 350 R P M; high, 22 M P H with engine at 350 R P M; gasoline capacity, 120 gallons; water capacity, 170 gallons.

THE CANADIAN PACIFIC has recently received two fire fighting tank cars from the builders, having tanks of 8,428 imperial gallons capacity. On one of these cars there is a 7 x 10 x 10-inch duplex fire pump at one end which uses steam from the locomotive. At one end of the other car is a hose rack which will hold 6,000 feet of 2½-inch hose. The cars are in the service of the operating department and are located at Brownsville Junction, Me.

Jolly the fellow who's down today,
Give him a smile for his sorrow;
For this old world has a funny way,
And you may be down tomorrow.

Traveling Engineers' Convention.

The twenty-first annual convention of the Traveling Engineers' Association was held at the Hotel Sherman, Chicago, Ill., August 12, 13, 14 and 15, 1913. The convention was called to order Tuesday morning by President W. H. Corbett and was opened with prayer by Bishop Fallows of Chicago. Next followed an address of welcome to Chicago by a representative of Mayor Harrison, after which the convention was favored with an address by W. A. Garrett, vice president of the Chicago-Great Western R. R. Mr. Garrett is one of those speakers who instantly gains the confidence of his listeners and his address, which contained both humorous and serious sides, was listened to with great interest. Fuel, said he, was the big problem of the railways and the traveling engineers were "the boys" closest in touch with the question. He said he would regret to see government-owned railways, but that if the roads could not make both ends meet, it would come to that and the traveling engineer must do what he can to cut down costs.

The president's adress was delivered by W. H. Corbett and after an intermission the secretary's report was read, which showed the association to have a membership of 957. The treasurer's report showed a balance on hand of $672.91.

UNIFORM INSTRUCTIONS TO ENGINEMEN ON HANDLING OF SUPERHEAT LOCOMOTIVES.

The principal advantages derived from the use of superheated steam are: The increased volume of steam delivered per unit of water evaporated, the prevention of cylinder condensation, and a much smarter engine. When we consider the fact that the heat losses in the cylinders of a saturated steam locomotive average easily 30 per cent, due to cylinder condensation, which is eliminated with highly superheated steam, and in addition the increase in volume, it is an easy matter to see why the superheater locomotive produces such remarkable results in the way of efficiency and economy.

Add to this the fact that the efficiency of the superheater locomotive increases as the load increases, while it is the reverse with saturated steam, and we have the reason for its being generally adopted by the railroads.

In the operations of a superheater locomotive it is necessary, as with all other devices, in order to obtain the most efficient and economical performance, that the enginemen be familiar in a general way with the construction and operation of the superheater as well as the nature of superheated steam, and while the operation does not require any radical departure from what has been the recommended practice for saturated steam locomotives, there are some operating featues which, if followed closely, will produce the desired results, while on the other hand, if they are not followed, the results are unsatisfactory and the full efficiency and economy of the superheater locomotive will not be obtained.

It is this feature of the superheater locomotive that we propose to deal with in this paper and your committee feels that with the aid of the discussion following the reading of the paper this association will be in a position to recommend "Uniform Instructions to Enginemen on Handling of Superheat Locomotives" that will meet with the approval of the best authority on the subject, and, if followed, will give to the railroads the benefits of remarkable results in the way of increased efficiency and economy which the superheater locomotive is capable of delivering.

One of the most important features to be considered is the firing question. Inasmuch as the efficiency of the locomotive increases as the degree of superheat increases, it can readily be seen that the flame temperature in the fire-box is a very important factor and it is quite necessary that the draft appliances be so constructed as to produce an even, steady pull over the entire grate, and a draft condition that will make the locomotive a free steamer. In order to obtain this, it is generally necessary to use a somewhat smaller nozzle, draft-pipe and stack arrangement.

On account of the smaller volume of exhaust steam and its higher velocity, a moderate reduction in the size of the exhaust nozzle does not produce the same bad effect as with saturated steam, and its reduction to produce the desired draft conditions may be reached before there is any noticeable effect in the way of back pressure. However, the necessity for these changes depends much upon the quality of fuel used and the operating conditions.

Firing should be light and regular and a high flame temperature maintained.

Keep a light fire, a bright fire, and a level fire, and if you do this you will have a hot fire and this is necessary to obtain best results. Close the fire-door after each shovelful.

Banked fires and applying fuel in large quantities must be avoided, as this practice produces a low flame temperature which materially reduces the degree of superheat and affects the economy and efficiency of the locomotive.

The kind of coal to be used has to be considered. For illustration: A superheater locomotive will give less trouble and will be more efficient using Colorado or New Mexico coal than it will with Iowa or Arkansas coal; this is on account of the former coals being almost free from clinker and slag forming properties, while the latter is very bad to clinker the grates and honeycomb the tubes, superheater units and flues. This is especially true during wet and snowy times when the percentage of moisture is high in the coal, all of which has to be evaporated before the coal will burn, and while this evaporation is taking place, instead of having a white burning fire, we have a red, smoky looking fire that has a temperature just up to the melting or fusing point, and the impurities which are present more or less in nearly all coal, melt and run and form clinkers in the fire and on the flue-sheet in tubes and flues. This occurs worse with old flues than with new ones.

The way the engineer starts his train has a great deal to do with this also. If in starting he gives his engine too much throttle, the first move causes the engine to slip, which helps to form clinkers and honeycomb on the flue-sheet and superheater units.

When making a terminal start, the condition of the steam being used is exactly the same as ordinary wet or saturated steam, and this condition continues until the superheater elements get in their good work, the steam gradually getting hotter and hotter and dryer and dryer. Enginemen should be interested in having flues kept clean.

Any stoppage of the flues reduces the boiler heater surface and in case of the superheater flues also reduces the degree of superheat, as the steam passing through the unit contained in the plugged flue is not superheated and when it is delivered in the superheat portion of the header its effect on the superheated steam is to reduce its temperature.

The enginemen should report promptly any indications of trouble in the front end, or other trouble that will in any way affect the free steaming of the locomotive.

Experience has shown that a very bad condition can exist in the front end of a superheater locomotive, and still the performance be reasonably satisfactory. Many cases have occurred where these conditions have become bad enough to cause a failure ordinarily before it was known that there was anything wrong.

Enginemen should always bear in mind that if a superheater locomotive does not steam freely there is something wrong which should be corrected at once.

Enginemen should report promptly any failure of the superheater damper to work properly, and in case it fails to operate on the road the damper weight may be tied up to hold the damper in open position until the trip is completed, and to avoid a failure.

If for any reason the damper on a road locomotive does not close when the throttle is closed, the engineer can always pro-

Main Exhibit Room, Traveling Engineers' Convention, Looking South.

tect the superheater units from overheating by slightly cracking the throttle when in his judgment it is necessary.

Another feature to be considered important is boiler feeding. Enginemen should feed the water regularly and carry it at a uniform level, making sure that it is not high enough to carry over into the superheater.

Any water carried over into the superheater will be evaporated by the heat passing through the large flues and in this case the superheater is being used as an auxiliary boiler with little or no superheat obtained. This is one of the most common and expensive mistakes made in operating this class of power.

Enginemen should bear in mind that the water consumption should be about one-third less than with a saturated steam locomotive in doing the same work and should regulate the boiler feed accordingly.

Enginemen should avoid the practice of filling the boiler too full before starting or when drifting.

Where the above practice is followed, the locomotive is slow getting under way, due to the superheat coming up slowly and usually the engineer runs two or three miles before it is necessary to apply the boiler feed and much steam is wasted at the safety valves.

Enginemen should always note the height of water in the boiler when taking charge of a superheater locomotive, and should not attempt to move it until the air pressure is pumped up and the brake in operation.

The common practice of filling boilers too full of water in engine houses and yards, make the above instructions necessary, because when the boiler is too full and the throttle is opened, the large volume of water passing into the superheater makes it difficult to handle the locomotive, particularly if the engineer is not aware of the conditions. This, however, is a very bad practice and should be stopped, but indications are that it never will be.

Cylinder cocks should be open before starting and remain open until dry steam appears, except when making station stops, when there is not liable to be any condensation in the cylinders.

Enginemen should run with a wide-open throttle where the working conditions will permit and with as short a cut-off as is consistent with the proper handling of the train.

It is not expected that an engineer will attempt to run with a wide-open throttle with a very light train and he should not handle a heavy train with a light throttle and an unnecessarily long cut-off.

Enginemen should bear in mind that the application of the superheater has practically increased the boiler capacity and as the efficiency of the locomotive increases in proportion to the increased pull on the draw-bar, they can work the engine much harder than is possible with saturated steam, when occasion requires it.

Another important feature to be considered is the valve and cylinder lubrication.

Owing to the fact that there is no moisture in superheated steam to assist in lubricating, it is generally necessary to use a little more oil than with saturated steam.

Enginemen must know that the oil feed to valves and cylinders is constant and where the cylinders are equipped with an independent feed about 75 per cent of the oil should be fed to the valves and 25 per cent to the cylinders. When the cylinders are not equipped with independent feeds and all of the oil is delivered in the steam way or steam chest, no reduction should be made in the total amount of the oil used.

Owing to the high temperature of the valve and cylinder walls when shutting off, and particularly at high speeds, it is consid-

ered necessary to admit a small amount of steam when drifting, in order to prevent the oil from carbonizing and also to prevent drawing in hot gases from the smoke-box.

In many cases special means of admitting steam to the valves and cylinders is provided for, but in the absence of this it is recommended to slightly crack the throttle when drifting until such a time as the valve and cylinder walls cool down.

If you keep enough steam in the cylinders when drifting to keep the air and smoke-box gases out, you will have very little trouble about lubricating with any of the best valve oils furnished. In other words, if you keep the steam pressure in your cylinders above atmospheric pressure, air won't get into the cylinders. It won't run in against a higher pressure any more than water will run up a hill, and the oil won't burn without air. It is just as necessary to have air to have a fire as it is to have fuel. In fact, it is the air that burns. It takes air, fuel and temperature for a fire. Steam, fuel and temperature will not burn. Steam in many cases is used to extinglish mine fires. The ability of the oil to adhere to the surfaces to be lubricated is very important.

It has been learned from experience that a great many of the troubles formerly attributed to insufficient or defective lubrication have been eliminated by the proper delivery of the oil, and the use of metal in valve chambers and cylinders most suitable to high temperature, and more care in fitting up the parts coming in contact with the superheated steam.

Enginemen should be prompt in locating and reporting blows; and any report of this nature should receive prompt attention.

Keep your ear on the alert for blows in valves and cylinders; the steam you are using now travels faster than it used to and carries away a great deal of your lubrication when blows occur.

Don'ts.

Don't expect too much out of the superheater; it is not intended to overcome blows or supply steam leaks or square valves, and it is like some children—won't keep itself clean.

Don't forget when switching that there is more steam between the throttle and cylinders with the superheater than with the saturated steam engine—the superheater holds some.

Don't carry water too high just because you don't hear any in the smokestack. You might be using your superheater to boil water instead of heating steam.

Don't think because your engine steams that you are getting the full value of the superheat; your engine may not be calling for the capacity of your boiler.

Don't close your throttle entirely on road engines until you get to going quite slow; your cylinder lubrication will be much better.

Don't shake the grates violently when the engine is working hard (we know it is easier, because we have done it, but it was wrong); it causes the tubes and superheater units to choke up more frequently.

Don't fire your coal too wet; it won't clinker so badly if reasonably dry. The more you rake the fire the more the flues will stop up. There are only two reasons why a fire should be raked; one, because too much coal is used, and the other because it is not put in the right place.

While there is a great difference in coal, there is not as much difference as in what you are able to get out of it. They tell us of the high number of heat units or B. T. U.'s in certain coal; what does that amount to, to us, if we are not able to catch them, harness them up and use them to our advantage?

Keep after the terminal forces to clean the superheater units. Watch this a little when you have an opportunity. You are liable to find them using anything from a short flue augur to a 1½-inch pipe. They should use about a ⅜-inch pipe, long enough to go through the flues, and this should be used with a high air pressure, along with suitable hooks and scrapers to fully clean the superheater units. If it is not done in this way they will not be clean, and the money invested in the superheater is worse than wasted, because you will then have a saturated steam engine with a low-pressure boiler with decreased heating surface, impaired water circulation drafted too strong through the lower flues, causing holes to come through the fire near the flue-sheet, which has a tendency to make them leak. If this is allowed you have a low pressure saturated steam engine with big cylinders, and generally nothing to put in them.

Committee:—J. W. Hardy (Chairman), Sheridan Bisbee, W. A. Buckbee, B. J. Feeny, J. H. Heath.

Discussion.

J. W. Eubank (Ches. & O.): With regard to short cut-off and wide open throttle, it has been my experience that it puts so much pressure on the valve that the engine works against itself. You get better results with the throttle not open so full.

G. E. Ryder (Locomotive Superheater Co.): Tests have shown that the most economical cut-off is from 25 to 30 per cent. It is better not to shorten the cut-off and to throttle down.

W. A. Buckbee (Locomotive Superheater Co.): When locomotives are changed over from saturated engines to superheat engines, in many cases the injectors are too large and unintentionally the engineer gets the water too high.

F. P. Roesch (El Paso & S. W.): About a week ago we tested out some superheat locomotives where they were changed from a heavy grade to a lighter one, operating with about a 50 per cent cut-off and a wide-open throttle. The temperature dropped as much as 80° but by throttling it quickly went back to the first mark—680°.

W. A. Buckbee: At speeds of from 25 to 30 miles per hour we get a back pressure of 4 pounds. The reason we have less back pressure with superheater is that we have eliminated cylinder condensation.

Robt. Collett (S. L. & S. F.): We have just made some fuel tests on a Pacific with the quadrant marked and found it did the best work at ⅝ cut-off. We also found that in 6 months an engine with a screw reverse effected a saving of 59 per cent.

A. G. Kinyon: Anything that applies to a saturated engine applies to a superheat engine. I have found that on 60 per cent of the engines I have ridden, the engineer makes an auxiliary steam generator of the superheater.

J. J. McNeill (Erie): Is there any difference in superheat on two engines of the same class, same steam pressure and same service, where one uses hard coal and one soft coal?

G. E. Ryder: That is taken care of in the design of the superheater.

W. G. Tawse (Locomotive Superheater Co.): With regard to the nozzle opening, I believe the best economy is effected by a reduction of the nozzle. Honeycombing is perhaps a question of lack of air. Keeping superheater flues clean is the most important thing in connection with the superheater.

A. G. Kinyon: We have more trouble with honeycombing when there are slight leaks in the flues. This moisture combines with the elements in the fuel.

W. C. Hayes (Erie): I recently visited the shops of a large trunk line and examined fifteen engines. I found all return bends encrusted with hard clinker extending out perhaps 2½ inches.

G. W. O'Neal (N. Y. O. & W.): If you find the firebox coated, change the grade of fuel. I don't believe the fireman has anything to do with it.

F. P. Roesch (El Paso & S W.): Try throwing limestone in the firebox. It will coat it white but you will find that clinkers will not adhere.

Mr. Hardy, in closing, said that instructions are intended for men who don't know; that the instructions in the paper were general and to be modified to suit local conditions.

WEDNESDAY, AUGUST 13.

The convention was favored with an address by W. J. Tollerton, general mechanical superintendent of the Chicago, Rock Island & Pacific, which was full of practical thoughts for the members. Among other things he said that discipline should be administered only in extreme cases, that young men with at least a grammar school education should be selected for firemen

and that a careless or indifferent fireman developed into the same kind of an engineer. Boxes should be installed at terminals where men could drop suggestions. Traveling engineers should see that all violations of Federal laws are reported. Repairs to locomotives represent 24 per cent of operating costs and fuel represents 42 per cent, so the traveling engineer has a chance to effect important savings. For instance, the loading of locomotive tenders should be looked into. The road foreman should aid the "Safety First" movement by getting engine men interested in protective devices.

CREDIT DUE TO OPERATING DEPARTMENT FOR POWER UTILIZATION AND TRAIN MOVEMENT THAT REDUCES CONSUMPTION OF FUEL PER TON MILE.

The study of fuel economics is scarcely a duty of the operating department, but moving trains and handling power in connection therewith are its chief duties and upon the efficiency with which it performs these functions a low or high fuel consumption largely depends. Its opportunities for aiding in keeping down fuel consumption through betterments of many underlying conditions, well within its charge, that have an indirect bearing on promptness with which power can be utilized and trains made up and delivered, are far from limited. Credit is due it for the betterments that result in actual savings in fuel and for endeavors to take advantage of opportunities tending to further savings. The true credit due is proportional, however, to the utilization it makes of these opportunities as a whole, considering possible savings that could be made if all were taken advantage of. While credit is due any department for every pound of fuel saved, the credit is grudgingly given if it is known that conditions exist, capable of remedy, whereby two pounds might be saved, where but one was saved. Paradoxical as it may appear, a seemingly low fuel consumption per ton mile may actually be a high consumption, and the maximum amount that should be used may be less than the minimum amount being used through adverse conditions of operation which might be reduced to a minimum if proper efforts were made: For illustration: Two railroads run side by side, under same basic conditions as to gradient, style of power, etc. On one line the fuel consumption per thousand ton miles has been one hundred and seventy-five pounds, which, by a supposed strenuous effort of the operating department, is reduced to one hundred and seventy pounds. The general manager boasts to the general manager of the competing line of this record and is informed that the fuel consumption per thousand ton miles on the competing line is but one hundred and fifty pounds. He investigates and finds the difference is due to such things as closer tab kept on reducing power in dull times, better judgment in assigning engines to runs suited them, more attention to trackage at turn-tables, ash-pits and coal-chutes, up-to-date methods of handling ashes and coal to prevent delays, yards modified from time to time to expedite switching and making up trains, block signals arranged so as to be seen a good distance away, close supervision of dispatching methods to prevent delays, rigid investigation of delays and prompt action to eradicate causes leading thereto; close attention to methods of inspection to prevent having to switch out bad order cars in terminal yard and en route, scientific loading in relation to capacity of power and weather conditions, judgment in regard to cutting down and filling out en route, and in seeing to proper facilities for quick switching at such points; judicious selection of stopping and starting ground at water stations and at block signals where conditions may make stops frequent, and to betterments of similar imperfect operating conditions, most of which were within the power of his operating department to have bettered. In other words, his five pound saving per thousand ton miles was but a crumb plucked from what might be termed "the table of operating extravagance."

The most deserved credit that can be given the operating department for results that bring about economy in fuel is that due for betterment in yard and road conditions and in methods of dispatching that go to make nearly perfect railroading, when these betterments are due, or largely so, to the intelligence, aggressiveness and persistence with which that department worked to obtain same. The operating department is in a peculiarly fortunate position in that it obtains a double credit for betterments that reduce fuel consumption, as this can only be done, so far as this department is concerned, through betterments which are, in a major sense, for its own direct benefit in providing for more prompt utilization of power and more efficient train movement, and it has therefore a double incentive to work for such betterments.

Among the features, some already lightly touched on, which the operating department controls to a more or less extent, and through study of which it can perhaps aid in reducing fuel consumption and demand credit for same, we might call attention to the limitation of power kept in actual service.

Ws assume that practically the maximum number of engines required to handle business at its height is assigned each division. Good judgment in shopping engines for repairs and in storing them during dull periods is an important item in fuel economy. We do not believe in limiting engines kept in service to a point that might delay freight through lack of power to move it, but while any train or number of trains may be moved with a low rate of fuel consumption when only fuel used in actually moving is considered, yet all fuel consumed by the engines of a division must ultimately be charged against the total train movement of such division, and engines needlessly lying ready for service and consuming fuel in idleness increase the fuel consumption per ton mile above the figure used in actually handling tonnage. If an engine, which when promptly utilized can cover the division with four tons of coal, burns a ton while waiting to be utilized, five tons must be charged against train movement and fuel consumption per ton mile is increased accordingly. The same is true of power held out on road beyond what would be a reasonable time under favorable conditions, when such delay is due to indifferent operative conditions. It is realized that delays are not always chargeable to the operating department, but closer final charges for fuel consumed are to the number of pounds per ton mile used in actually handling train, the greater will be the credit due that department.

In storing engines, we believe in keeping those in service whose mileage comes nearest entitling them to shopping. If poorer engines are stored, the good ones are being worn out during the dull season and when the rush season comes this department is handicapped by having the majority of its power in poor condition. With poor power in use during dull periods, the tendency of such power to break down is not as likely to cause delay to following trains, with accompanying waste of fuel, as in the busy season when trains run closer together.

Credit should be given to operating department by the fuel economist when it exerts its influence to have maximum amount of power repairs made in dull seasons. Judgment in assignment of differential classes of power to sections best suited each class, or assignment of such variety of power to various sections as the peculiar requirements of such sections demand, is important to fuel economy. While each division operating department may not always obtain the power best suited to its needs, judicious assignment of such power as is at its command to runs best suited each class, aids in keeping down fuel consumption and brings corresponding credit.

Whether we consider power as in the hands of the operating department to utilize from the time assigned to the division, or only from the time made ready for service, this department has a direct interest in facilities for speedily turning at points where turned. Whether in direct charge of turning or not, it is entitled to credit for aid in procurement of betterments that make quick turning possible with accompanying economy in fuel. This calls for good arrangement of trackage to and from yards to turn-table, ash-pit, coal-chutes and water tank, and a sufficient and efficient turn-table, ash-pit, coal-chute and water crane arrangement whereby, particularly at busy termi-

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nals, a more or less continuous "blocking up" condition is avoided.

Yard conditions, terminal and en route, are perhaps the most prolific source of train delays that result in increased fuel consumption. Terminal yards should be large enough to permit prompt entrance of incoming trains and provide for quick movement of power to engine terminals. Yards at intermediate points should provide for speedy switching where necessary to pick up or throw out cars and for prompt obtainance of water and fuel when necessary. At large terminals, separate yards for making up trains going in opposite directions, classification tracks in connection with making up, provision for proper storage tracks, cripple tracks of easy access into which bad order cars may be thrown for repairs, which are to be used exclusively for this purpose, and "making up" tracks, long enough to hold maximum length of trains hauled, thereby avoiding switching incidental to making up on two tracks, all tend to promptness of train movement and minimizing of fuel consumption. Provisions to accelerate movement of road engines to waiting trains, avoidance of switching movements by road engine after coupling up to trains as in throwing out bad order cars, filling out, etc., and provisions for prompt getaway of trains, are equally important. Hump yards are an efficient means of reducing fuel charges in switching service by reducing switching power. Credit is due to operating department for being instrumental in having these installed. Experience is teaching, however, that unless closely watched they not only run up car department costs, but are not as conducive to fuel economy as might be, due to failure of yardmasters at some points to see cars are not prevented by riders from striking with sufficient force to damage them. This frequently results in delays due to making repairs or throwing out badly damaged cars and is believed a material cause of break-in-twos en route due to damage done to the drawbar rigging by permitting such serious impacts, with increased fuel consumption due to such delays. While giving credit for betterments promoting prompt train movement and fuel economy, none of the saving gained should be lost by unnecessary carelessness.

Power should be loaded to not more than 90 per cent of maximum capacity under best conditions and this varied according to weather conditions. As a matter of fact, fuel is sacrificed by underloading as well as overloading. Where a grade on the division is not sufficient to justify pusher service, if trains were loaded so to make certain they would not stall on such grade they would be underloaded over the rest of the division, causing considerable loss in ton miles and increased fuel consumption per ton mile. Local conditions should be carefully studied to determine most economical load for the territory. Make-up of trains as regards heavy and light cars is important, as the further from the engine the heavy cars are, more flange friction is increased on curves and the harder the train will pull. Efforts should be made to place heavy cars at head end of train. Judgment, however, should be used in order not to bring about bad breaking conditions.

While train inspection is not usually directly in control of the operating department, it bears such intimate relation to train movement that this department is vitally interesed in it. Prompt inspection of trains, providing adequate facilities for such inspections, for making light repairs, for throwing out bad order cars, for inspection and testing of air brakes before road engine is attached, or arrangements for quick test after attached, are of direct benefit, and incidentally to fuel economy.

Water troughs permitting water supply to be scooped are an efficient means of lowering fuel consumption by cutting out train delays incidental to stopping for water. The operating department is entitled to credit for such fuel savings where these have been introduced through its efforts. Where water cranes are used, special attention should be given lay of ground in immediate vicinity with reference to ease with which trains can be stopped and started in either direction and when located in yard limits that trains while standing will not block switches, cross-overs or public highways, or interfere with other power movements. Water tanks should be spaced so that heavy loaded trains can get over the division with minimum number of stops for water. In bad water districts water treating plants should be installed. Where necessary to take coal en route, facilities

provided should be with a view to ease in getting to and obtaining to avoid unnecessary delays or interference with movements of others or permitting such other movements to delay quick coaling of through-going power.

Where block signals are in use, locating same so they can be seen a reasonable distance away from the approaching train, preferably on the engineer's side, but from one side or another, is important. So, also, is proper maintenance of lights thereon, their size and focus of lens. Being required to reduce speed on account of not being able to see the signal until almost at it, to avoid running past if set against train movement, is not an uncommon cause of slow movement and, therefore, not conducive to fuel economy. In congested districts, where stops are likely to be frequent, location of signals with a view to good starting ground, is of importance. Automatic block signals are decided improvement over mechanical or hand-thrown signals, on account of being closed together, enabling inferior train to occupy the main track closer in time of superior train and to start out closer behind superior train, thus bringing about more prompt train movement and less delay in allowing superior trains to pass, which results in fuel saving.

Handling train orders from towers without requiring train brought to standstill, is important to prompt movement. Handing orders to crew in passing at low speeds by means of hoops and staffs is in successful operation on several roads, and credit for accompanying savings in fuel is due to the operating departments that adopt it. In automatic block territory on ascending grades, heavily loaded trains should be allowed to proceed under caution instead of coming to full stop. In manual block territory on ascending grades, caution cards should be handed on by hoops instead of stopping the train. The use of telephone boxes at outlying points for the purpose of directing crews with reference to train movement, is also a distinct aid and source of credit to the operating department. Utilizing track against current of traffic can be frequently done to good advantage, i. e., advancing, for instance, an eastbound train on the westbound track, while allowing superior trains to pass when said track would be unoccupied. If not done, trains advanced would be standing in siding. This is time gained with accompanying economy of fuel.

Local way freight or pickup trains, where conditions warrant such, for distributing freight from terminals to local points, attending to local switching, gathering up local freight and bringing to terminal points to be made up in through trains, thus avoiding delay in stopping through trains for these purposes, is also a means of cutting down fuel consumption and a source of credit to the operating department that adopts it. Where work on the division is more than local trains can do, accumulation should be switched at some point on the division where readily picked up by a through train stopped for that purpose.

Whether best to pool power or assign each engine to regular crew, is a problem important to fuel economy. Admitting a regular assigned engine is given more attention by the engine crew, may get out on time more frequently, and with a good engine crew may perhaps cost less for maintenance, yet with the growing tendency to take responsibility of doing work on engines off engine crew and placing it on the shop, the advantages of assigned engines are becoming less. The sixteen-hour law makes it practically impossible for an engine crew to follow an engine unless the engine is held a long time at terminals, which cannot be thought of when yards are congested. If the engine is not held, the engine crew that brought it may not see it again for a week, which practically places the engine in pooled service. If men could, as formerly, follow their engine with whatever rest they themselves considered sufficient, the assigned engine would be ideal. If the assigned engine is in better condition, it is only because the engine crew is continually reporting work and following up same to see it is done. If engineers on pooled engines were educated to take the same interest in promptly and intelligently reporting work on every engine brought to terminal and were held to strict accountability for reporting all defects, and the shops were required to do the work reported, there would be little, if any, advantage in assigned engines over pooled engines. While every railroad has its portion of indifferent engineers, the pooled engine will occasionally even now, get the care of the interested engineer. It is a well-known fact that the same volume of business can be handled with less number of pooled engines than assigned engines, which should result in a corresponding lower total fuel consumption.

Minimizing running of light power is important to fuel consumption. During periods when run of business is heaviest in one direction, double heading power to be returned, is believed to be the preferable method, as with two engines on a train the possibility of delays due to failure of power is reduced to a minimum.

Sidings of sufficient length to hold maximum train handled and not too far distant from one another in which trains can be placed when necessary through failure of power or on account of hot bearings, necessity for re-brassing cars, etc., and into which crippled cars can be thrown and cars placed when necessary to cut down tonnage or to double grade, etc., are important to prevent delays either to the train in trouble or to following trains, with accompanying fuel economy.

These problems and conditions, and undoubtedly others of similar import that members of the association can bring up, are live issues. They have an important bearing on fuel economy from an operating point of view. The perfect railroad and perfect railroading do not exist and probably never can. The constant changing in business conditions, in power conditions, and in maintenace of way conditions, forbid the expectation of that. Improvement is always possible where conditions are never perfect and the measure of credit due to the operating department for low fuel consumption per ton mile lies in the progressiveness, strenuousness and the persevering continuity of its efforts to bring about perfect operating conditions and dispatching methods in its territory. Passive acceptance of existing conditions where such conditions are but indifferent, never raises the standard of efficiency. With railroads hampered, as they are today, by restrictive laws and rate-making legislatures and commissions, the recognized successful railroad men are those who can increase the company's net income by limiting the amount of its financial outgo, and in so far as the efforts of the operating department are successful in bringing about conditions that cut down the fuel consumption per ton mile, it need have no fear of not receiving the full credit thereof.

Committee:—M. J. Howley (Chairman), T. B. Bowen, J. C. Petty, J. W. Nutting, G. H. Travis, P. J. Miller.

Discussion.

C. T. Rummell (Balt. & Ohio): An item not mentioned in the paper is the quality of the sand. It is one of the most important things. A good grade of sand decreases the maintenance of the sand pipes and sanders.

F. P. Roesch (El Paso & S. W.): The higher operating officials are interested in saving fuel but when you get down among the trainmasters and yardmasters, they are more interested in getting trains over the road. They can do as much as anyone.

Angus Sinclair: The sand of the seaside is pure silica and is the best sand to use. We will soon pay as much attention to proper sand as we do to proper coal.

C. F. Richardson (Ky. Coal Co.): Roads which traverse a rolling country usually have water tanks at the lowest places. Trains have to stop there and it takes coal to bring the train to the top of the knoll. Roadmasters sometimes put out slow orders and let them remain long after the work is finished. Money is lost in this way and the traveling engineer should see that these are taken up. Switches are often put in at such a point that it is hard to pull in. All these things affect fuel economy.

J. W. Hardy. The average movement of freight is 20 miles

per day and it should move faster. I think that 30 per cent of the fuel used today is used by engines standing still.

Robt. Collett (S. L. & S. F.): I would suggest that it is a good proposition to put deadhead equipment on fast through trains with plenty of power rather than putting it on local trains. A great deal of fuel is burned up at terminals. The transportation department can greatly affect fuel consumption in the handling of time freight. During the last few months a statement has been issued from the office of our vice president in charge of operation, showing what each division has saved or lost. This gives the local officers something to watch.

C. W. O'Neal (N. Y. O. & W.): The manner of cleaning fires has not been mentioned. Ninety per cent of the roads use men who are only interested in getting the engine off their hands at the terminal. Much fuel is wasted at the ash pits as often there is good fuel left in the fire-box.

R. C. Hayes (Erie): I think it would be well to have this paper brought up at meetings of road foremen and other officers when we get home.

ELIMINATING BLACK SMOKE.

The paper on "What Can we Do to Eliminate the Black Smoke Evil on Locomotives?" was read by Martin Whelan on Wednesday afternoon, abstracts of which follow:

You should stop and consider carefully what the general effect of the electrification of railroads and industrial plants would be, and then say whether or not in your opinion the question of what can be done to eliminate the black smoke evil is not an important one—not only on locomotives, but also in industrial plants. In large industrial centers the locomotives are responsible for but a small percentage of the total smoke if the railroads make an effort to eliminate it, and the electrification of the railroads in such centers would have comparatively but small effect on the general smoke conditions unless the industrial plants were electrified also.

We all agree that smoke escaping from a locomotive stack is a waste, and the greater the volume of smoke the greater the loss. The emission of black smoke is a sure indication of imperfect combustion. It is also an infallible sign that there is some condition existing in the fire-box that is detrimental to combustion, and the question is: Could that condition have been averted? In other words: Can the emission of black smoke from the stack of a locomotive burning bituminous coal be prevented, and how can it be done? It is known that it can be done, because locomotives are seen working in all kinds of service, both heavy and light work, and frequently dragging trains up a long grade at slow speed, and in ten hours' work they seldom make No. 2 smoke or even No. 1 of the Roberts chart, which is based on the same standard as the Ringleman used by the United States government. The only difference is that the Roberts chart is much more convenient for locomotive observation.

The most effective device by which to accomplish smoke elimination is a number of combustion tubes used in conjunction with steam jets. The tubes are located in the side sheets or back head of a boiler. The number in the side sheets usually varies from four to seven on each side. They are two inches in diameter and are applied by removing the fifth or sixth stay-bolt above the mud ring and in enlarging the hole to fit the two-inch tube. Where the tubes are located in the back head they are usually placed above the fire door. The object is to admit air above the fire and to mix it with the gases as they escape from the burning coal. The steam jets are connected by half-inch pipe with a ⅜-inch nipple entering the tube. Some roads have the nipple opening just flush with the outside sheet and others go to the other extreme and extend it in almost to the inside sheet. The reason for this difference is that when placed outside the noise is very annoying and it requires constant watching to get the engine crews to use them. The noise is greatly reduced when they are extended inside. The tubes

Annex Exhibit Room, Traveling Engineers' Convention.

located in the back head are also very effective, but the noise is very objectionable.

The next requirement is the blower connection with a 1¼-inch pipe extending from the fountain to the smoke box. The multiple blowers are preferable because they are almost noiseless, but objectionable because the small openings soon become filled with dirt. The double tip blower is the most serviceable and is generally used on that account. The blower pipe should have a quick-acting auxiliary valve located so that the fireman can reach it easily from either the deck or the seat box. The steam jet connection is usually made to the blower pipe, either above or below the auxiliary blower valve, preferably above, so that the steam jets can be controlled independent of the blower, as there are times when the engine is using steam that it is found necessary to use the jet and not use the blower. The valve which controls the steam jet should be located close to the auxiliary blower valve.

The brick arch is a great help when using steam, but is of less benefit when the engine is shut off, unless the arch is sealed against the flue sheet. In switch engines it is usually sealed against the flue sheet. When this is done it will pocket the smoke and gases and prove a great benefit. There is the objection of cinders and dirt accumulating on top of it, and this is true, but it has been found that after two weeks' service between washouts the amount of cinders will seldom cover more than two or three rows of flues. On freight and passenger engines there is an opening left between the flue sheet and arch, as they are almost continually using steam, and if properly handled by the crew will make no smoke.

Another device that is frequently brought into discussions on smoke elimination is the mechanical stoker. Although it is doubted that the question of smoke elimination was primarily considered by the designers of any of the locomotive stokers, still it is believed that it should be considered, as smoke from locomotives has been declared by a law a nuisance in many places, and while the absence of smoke does not always indicate proper combustion the presence of it does indicate improper conditions. Several of these stokers were tested, but with one exception they made a great deal of smoke. The only one that is nominally smokeless is an underfeed stoker used on the Pennsylvania Lines west and known as the Crawford stoker. This stoker has been used in all kinds of service and is known to be a success as a smoke eliminator. It is still in the experimental state and is not on the market, although the Pennsylvania Lines have a large number of them in service.

Co-operation on the part of the engine crew is of the greatest importance. Without it mechanical devices are a failure. The most effective preventer of black smoke is the man behind the scoop. A fireman who has a fair knowledge of the principles of combustion and makes use of that knowledge will make a better showing on smoke elimination than a disinterested one will make with all the known devices or even the best grades of coal. Experts may spend time and money figuring on the best methods, etc., but all devices are more or less dependent upon the human element. None are fool-proof, and such being the case we are brought down to the conclusion that the men on the locomotives are the principal factors and therefore it becomes necessary to work along the lines of first getting them interested and then educating them. We are frequently told by engineers when we complain of smoke violation on engines that are fully equipped with the best known smoke-preventing devices (and they are frequently the worst offenders), that they cannot get the firemen interested. We are told that we are employing a different class of men from what we did some years ago, and we must admit that we are, because as a rule the men whom we employ at the present time have the advantage of a better education. In the twelve years that I have held the position of road foreman I have always hired firemen who were better educated than I was when I commenced, and I was as good as the average at that time. Why are firemen not interested and what can be done to overcome this lack of interest, is the great problem of today, and until it is solved, smoke elimination is a difficult proposition.

We all recognize that the firemen of today have not the advantages of the regular engine or the regular engineer. That has been taken from them. Arrangements have been made to take care of the pooled engines, but we have failed to arrange for the changed conditions that the pooled engines have forced on the firemen. All progressive railroads maintain apprentice schools for the purpose of educating the mechanics, but how many pay any attention to the education of the firemen? The mechanical apprentice, after serving four years, still continues under the eyes of a foreman, whereas the fireman after three years spent feeding coal into a fire-box is considered competent to assume the responsibility of managing a locomotive on a busy railroad. The apprentice just out of his time may leave the railroad that educated him and never return, whereas the promoted fireman usually remains during his life, and once he becomes an engineer, he has no foreman immediately over him in his daily work, but instead he becomes a foreman himself.

Daily observation has convinced the writer that the engine crew is the main factor in smoke elimination. The devices assist only in proportion to the degree of intelligence used by the engine crew. In a district like Cleveland where the smoke question is followed closely, we are able to fully appreciate the value of it over the conditions that existed before the question was given any consideration. There is considerable saving in fuel owing to the fact that the men are educated to put in small quantities of coal at a time; as a result of this the fire is kept in better condition, there is much less work cleaning it on the ash-pit, less trouble with tubes leaking, fewer engine failures, and finally when these firemen are promoted to road service we hear less of engines not steaming on account of poor coal. In the Cleveland district the crews are disciplined for violations where such violations are the results of carelessness. Both engineer and fireman are held equally responsible. For the first offense they are warned, and if they still continue to disregard the instructions they are suspended, usually for ten days.

In conclusion it is the opinion of the writer that if engines are equipped with the ordinary devices for the prevention of smoke and the engine crews are properly instructed as to their use and the proper method of firing a locomotive, there will be but little cause for complaint on account of objectionable smoke.

Discussion.

A. G. Kinyon—I am in the New England territory and the greatest difficulty to overcome is not in getting railroads to put on proper appliances but to get the men educated. There should be a man for every fifty engine crews or even for every twenty-five crews. More supervision should be given to the work on the engine today.

Fred McArdle (S. A. & A. P.)—Fifteen miles of demonstration will do more good than thirty days of talking. No matter how many steam jets there are, you must have the co-operation of the enginemen.

In the course of the discussion a member stated that if the engine was fired at the sides first and then in the center after about two minutes, that it did not smoke. Another member said that it was time to teach the engineer to fire by the steam gauge and not by the stack.

THURSDAY, AUGUST 14.

ADVANTAGES OF THE BRICK ARCH.

The paper on brick arches by Le Grand Parish was read by F. F. Gaines. Abstracts follow:

The general introduction of the brick arch in the past few years has been brought about by the necessity for increased boiler power and sustained steam pressure. The other incidental advantages, which, in themselves, are large, are subordinate to the necessity for increased power per pound of metal.

The locomotive builders were among the first to advocate the application of the brick arch and superheater, which are referred to by the builders as fuel-saving devices. They recognized the fact that, where the weight on drivers had reached the maxi-

mum, increased power must come from sustained steam pressure. These, as well as any other devices which will aid in bringing about this result, are receiving earnest attention by mechanical and operating officers. Important improvements are being made in the form and application of brick arches and arch tubes, as is evidenced by the recent combination of the sectional arch on tubes and the Gaines Furnace. These improvements are the inventions of men in railroad service who are trying to improve the steaming capacity of the boiler. The long fire-box with a suitable combustion chamber, shorter flues in some cases, improved front ends, improved grates and better air admission in the ash-pan have given surprising results. Important improvements in exhaust nozzles and passages in the saddle have also been developed in the past few years. All of these things are essential to the successful operation of the locomotive, and every detail that will in any way result in the increased capacity of the boiler is imperative today.

One result of the application of arches is to reveal weaknesses in other factors affecting combustion. It is frequently necessary to give immediate attention to the admission of air through the grates. This is usually done by cutting down the nozzle, whereas the fault lies in the ash-pan. The fire must have air, and when it is considered that it is necessary at times to use twenty-five tons of free air per hour (or a volume equal to 350 box cars of air), we better appreciate the problem which confronts us when this has to be drawn in by the exhaust nozzle. The more difficulty experienced in getting air into the ash-pan, the more back pressure we produce in the cylinders. The speed of the air entering the coal on the grates when burning one hundred pounds of coal per square foot of grate per hour is approximately sixteen miles per hour. Its velocity is increased after passing through the fire on account of the increase in volume due to increase in temperature. The speed of the gas entering the flues would increase to approximately 180 miles per hour on a locomotive with seventy square feet of grate and eight and one-half square feet of flue opening, such as is found in our large Mikados. This will give a fair idea of the difficulty in burning the gases before they escape. The arch, acting as a baffle wall, retards the gas only to a limited extent, but long enough, however, to give a better mixture of the air and gas and greatly improve the combustion.

It is a well known fact that the length of the flame-way is the all important factor, because the gas must have sufficient travel to complete its series of explosions before it enters the flues.

The fact that the value of the fire-box heating surface is seven times the value of the same amount of flue heating surface was brought out in the Jacobs-Shupert fire-box tests conducted by Dean W. F. M. Goss, of Coatsville. The long box equipped with a sectional arch, or with the Gaines combustion chamber, insures the proper distribution of heat over the fire-box sheets. The longer fire-box is a protection to the flues to just the extent that the combustion is more complete. The cold air from the door has a longer travel, and, naturally, absorbs more heat.

Another important matter which must receive constant attention is the care of the arch tubes. No trouble whatever is experienced from scale when a mechanical cleaner is used to cut it out of the tubes at each boiler washout. This practice is now quite general and should be universal.

There is no difficulty experienced from bad water where the tubes are properly cleaned. Washing will not answer the purpose—the scale must be cut out. This practice has been in effect on all water tube boilers of the stationary type for years, and the water tube boiler is in common use in all bad water districts. It was the successful use of the mechanical cleaner in water tube boilers that brought about its general use in locomotive boilers and made the use of the arch tube a practical success. The flow of the water through the tube is reduced very rapidly as the scale increases, due to the rough surface of the interior of the tube.

The value of the arch tube as the means of better water circulation has not received the attention it deserves. The history of the arch tube shows clearly that it was originally applied as a means of support for the arch, and its value as a circulation device was not seriously considered. Later it was accepted as having some value. In this respect today its value is of decided importance. The problem in good steaming is to utilize the full value of the heating surface. Flues which lie below the center of the boiler have difficulty in getting rid of the heat. The only way that this may be accomplished is by getting a more rapid circulation of water in the bottom of the boiler. This will be better understood when it is known that, when the boiler is working up to its capacity, four 3-inch arch tubes will circulate fully 30,000 gallons of water per hour, when the discharge end of the arch tube is designed to discharge at the surface of the water. The boiler of a consolidation engine of modern type ordinarily contains about 3,500 gallons of water. From this you will see that the circulation is very rapid.

The 3-inch arch tube (2⅝ inches internal diameter) in common use today is the minimum size that should be used, as the diameter of the tube has a direct relation to the amount of water circulated. If the tubes were reduced to one inch, it is quite probable there would be no circulation except that required to replace the water evaporated into steam in the tube. In other words, the tubes would flash the water into steam of a high temperature, and practically no water would be carried out with the steam. It is quite possible that the future will see the use of circulating tubes of greater diameter than three inches. A proper design should give all the additional benefits to steaming that are obtained in water tube boilers of the stationary type.

We expect to see a decided improvement in locomotive boilers due to better circulation. More rapid circulation of water on the heated surfaces will increase the evaporation on account of the rapid replacement of the hot water with colder water. The scouring effect of the water will take up and carry away the heat, allowing the colder water to come into contact with the heated surfaces. It will be necessary to give attention to this feature if we expect to secure the benefit from a higher velocity of gases over the heated surfaces. Heat will flow rapidly through a sheet when there is cold water on one side, and will flow less and less rapidly as the temperature of the water increases. This may be illustrated by the trouble which was experienced with bottom combustion chamber sheets before arch tubes were applied. The over-heating of the sheets was due to the fact that there was no circulation to take away the heat.

Improved steaming means better fire-boxes, and this means more satisfactory operation. The relation between the air supply, the coal and the arch is so intimate that they must be considered together.

Free access of air into the ash-pan is very important. The cases are rare where too much air is admitted through the grates when they are properly covered.

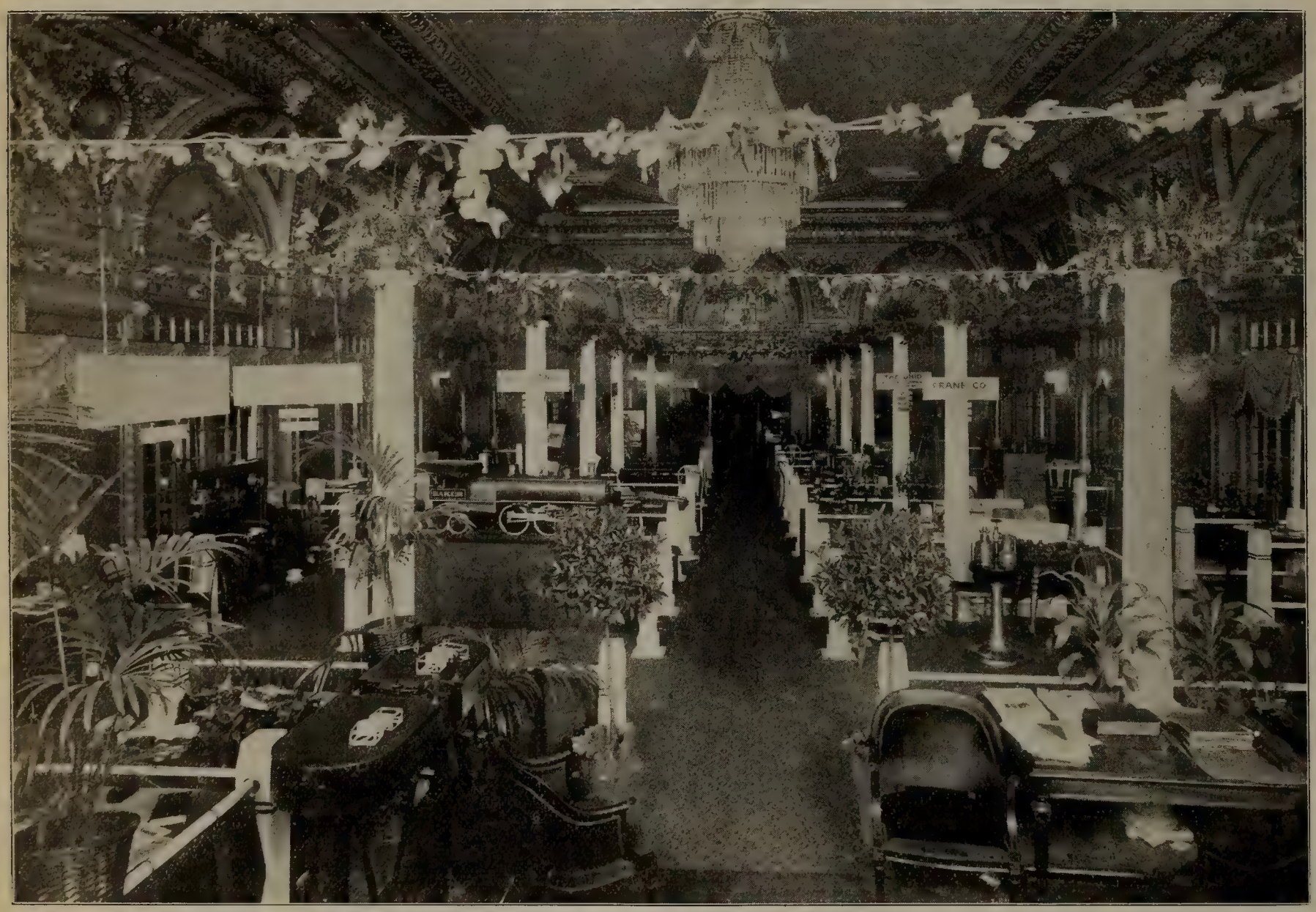
The important improvements in the future must come from improvements in nozzles or draft; improvements in grates and air supply; improvements in water circulation, and, last but not least, the development of longer combustion chambers.

The theory of a combustion chamber as applied to a locomotive is quite simple. The fixed carbon burning on the grates distills the volatile matter which is below the temperature of the heat which produced it. By adding the proper amount of heated air to the volatile as it passes over into the combustion chamber, the volatile is ignited and the temperature in the combustion chamber raised above the temperature over the fuel bed. The complete burning of the volatile depends upon the proper mixture of air and the length of the combustion chamber.

Anything mechanical that will aid in making a better mixture of the gas and air will improve combustion. The long combustion chamber increases the distance the gas has to

travel on its rapid race to the flues, and gives more time for the gas and air to unite in the proper mixture and complete the series of gas reactions, or explosions, before they reach the flue-sheet.

Improvements in the locomotive have been made so rapidly that it is difficult to realize the importance of keeping up with the development. More expert supervision is necessary in order that proper results may be obtained, and the burden of this expert supervision upon the members of this association. The success of any device, no matter how small, depends upon the information which the manufacturer is able to obtain from his own experts and the experts having charge of the device on the railroads. We are, therefore, mutually interested in the highest development of the service. The rapid development



Main Exhibit Room, Traveling Engineers' Convention, Looking North.

has brought about the necessity for more expert supervision, and the staff of the manufacturer is being drawn from the ranks of railway service and is made up almost wholly of men who specialize in the work for which their railroad experience has fitted them.

It has been stated at one of your meetings that "the arch is the best device for instructing firemen how to fire properly." This statement should receive the attention it deserves. The arch does not admit of using an excessively heavy fire; therefore, the fireman does not have to be instructed on this important factor.

The value of the brick arch as a smoke preventive is too well known to dwell on the subject here. The cost of the arch is overshadowed by the fuel saving, and the maintenance cost can be kept very low with proper supervision and by having sufficient material on hand at all times to make the necessary and proper renewals promptly. Failure to make these renewals at the proper time often necessitates a complete removal of the arch. If the arch is of value, it should be maintained in 100 per cent perfect condition all the time.

The whole subject of the brick arch is tied up so closely with the question of proper drafting that it is not wise to apply an arch without full knowledge of its relation to the grates and exhaust nozzle.

A large amount of useful instruction and detail might have been covered in this paper, but it would appear to be unnecessary at this time on account of the large amount of work that has been done in the line of instruction by this association at its previous conventions.

Discussion.

J. R. Scott (S. L. & S. F.)—In placing the brick arch close against the flue sheet we found that clinkers formed along the line of the arch and flue sheet which when heavy enough would fall and accumulate on top of the arch and crowd against the flue sheet. Best results are obtained by moving the arch back four inches, which allows the clinkers to fall through.

D. R. MacBain (L. S. & M. S.)—On the Lake Shore we used to have the impression that you must fill the smoke stack with the jet in order to have a good steaming engine. We found, however, that the jet struck one side or the other, with the effect that there was just about one notch the engine could work at, so we provided a big enough stack and means for passing the jet straight through the center. The best records show about four or five pounds pressure at the top of the stack.

We have over 350 superheaters running successfully, but the evil is that the enginemen use the superheater units as an evaporating proposition. Tests recently made with the water high enough to prime a little, show that it puts the efficiency right back where it was with the saturated engine. Men are

getting so they carry the water out of sight and the road foremen should correct this.

We use the brick arch for smoke prevention in the Cleveland district. On our switch engines we filled the whole firebox full of brick and took out three 10 x 13-inch holes at the back. We use no petticoat pipes.

W. A. Buckbee (Locomotive Superheater Co.)—Many engines today have not enough ash pan opening. If the flues leak occasionally with the arch close up they will stop up. On roads where the engine is dumped after each trip the most success is obtained with the arch close up against the flue sheet. I believe the arch saves about 10 per cent in fuel.

L. D. Gillett—I have had experience with and without the brick arch and, taking into account the cost of replacement, have found it a detriment.

D. R. MacBain—On the New York Central the firemen have two feet of fire from one end of the run to the other. Every Lake Shore engine has a brick arch carried on pipes. We have welded in the flues on 300 engines and so don't have to calk them.

W. C. Hayes—We have proved on the Erie that the brick arch saves about 10 per cent in fuel and our practical experience has been that the lightest fire that can be maintained gives the most economical results and gives the most steady steam pressure. I have looked into the operation of all the stokers and they are not successful until the fire is kept so thin that if the stoker is shut off you have to put in fresh coal to keep your fire. Light and level firing is the only sure way to get results. A heavy fire resists air admission.

D. R. MacBain—There are more flue failures through light firing than any other source. A shovelful of coal thrown onto a heavy fire causes less smoke than when thrown onto a light fire. The cost per locomotive mile tells the story.

Thursday afternoon the convention was favored with an address by W. L. Park, vice-president of the Illinois Central. He spoke of the comparisons made of our roads to foreign roads as to accidents and said that during the past year 114 had been killed in passenger train accidents in this country while 6,000 were killed by trespassing. The lawmakers must make laws to keep people off tracks. He said that the traveling engineer could do nothing of more value than to post himself on financial matters—that he must spread publicity as to the difficulties of the railroads to the people. The railroads now have a hard time to pay dividends and it is hard to borrow in Europe as its confidence has been shaken.

LOCOMOTIVE BRAKE EQUIPMENT.

Following Mr. Park's talk the paper on "Care of Locomotive Brake Equipment on Line of Road and at Terminals, Also Methods of Locating and Reporting Defects," was read by F. B. Farmer in the absence of the Chairman, Mr. Flynn. This paper was devoted largely to piping defects and similar defects met with on the road, it being assumed that repair work was efficiently taken care of at terminals.

In the discussion Mr. McArdle, of the San Antonio & Aransas Pass, said that the air pump had been overlooked and no mention had been made of ways in which the engineer might make repairs on the road. He said that there was nothing complicated about the pump and gave instances of how repairs could be made, in which the "village blacksmith" figured prominently. Mr. Farmer took the other side and said that breakdowns of the air pump were very few and that when they did occur it was better to send help than to go to the time and trouble of educating every engineer. This discussion was contiued over into Friday morning.

FRIDAY, AUGUST 15.

E. W. Pratt, assistant superintendent of motive power of the Chicago & North Western, was present at the Friday morning session and gave the members a short talk. He spoke of the importance of keeping up the engine foundation and said that on the North Western they had nearly reached the stage when they would have regular engines for all. The proper employment of men was also touched upon. He also touched the subject of tonnage rating, saying that we must not give the operating department the impression that we don't want to pull more tonnage. We should object just as much to too little tonnage as to too much.

Continuing the air brake discussion the opinion was expressed that superheat valve oil was not good for air pumps on account of the low temperature, which tended to gum up the ports. Mr. Corbett said that the practice on the Michigan Central as to air pumps was to assign them half the mileage of the engine from shopping to shopping.

ELECTION OF OFFICERS.

The election of officers for the coming year resulted as follows: F. P. Roesch, president; Robert Collett, first vice-president; J. C. Petty, second vice-president; J. W. Hardy, third vice-president; D. Meadows, treasurer, and W. O. Thompson, secretary. The following were elected members of the executive committee: W. H. Corbett, D. E. Preston and J. R. Scott Chicago received the highest number of votes in the ballot for the location of next year's convention.

W. O. Thompson, A. S. Worth and W. H. Corbett were appointed a committee to confer with a like committee from the supplymen with regard to erecting a monument over the grave of the late C. B. Conger, first president of the association.

A resolution to appoint a press committee consisting of two traveling engineers and two supplymen was approved.

The following were appointed the committee on the progressive examination question and answer book: W. H. Corbett, J. F. Jennings, J. B. Kelly, M. H. Haig, W. G. Tawse, P. J. Miller, W. J. Hurley and Geo. Anderson.

W. C. Hayes, chairman of the subject committee, reported the following committee subjects for the coming year:

1—Smoke abatement. Difficulties accompanying dense black smoke and its relation to the cost of repair.

2—Operation of the locomotive with a view of obtaining the maximum efficiency of fuel economy.

3—Advantage to be derived from the locomotive stoker.

4—Air brake equipment. (Committee continued.)

Also papers on:

1—Advantages derived from the use of a speed recorder and its influence on operating expenses.

2—The chemistry of combustion.

3—Scientific train loading and tonnage rating.

RAILWAY EQUIPMENT MANUFACTURERS' ASSN.

At the annual meeting of the Railway Equipment Manufacturers' Association, held in connection with the Traveling Engineers' Association, the following officers were elected for the coming year: President, Frank H. Clark, Watson-Stillman Co., New York; secretary, Wm. S. Furry, Ohio Injector Co., Chicago; treasurer, P. H. Stack, Galena-Signal Oil Co., St. Paul, Minn. New members of the executive committee are: F. M. Bard, Barco Brass & Joint Co., Chicago; J. D. Purcell, Dearborn Chemical Co., Chicago; Jos. Gettrust, Ashton Valve Co., Chicago.

The following firms exhibited at the convention:

American Arch Company.
American Brake Shoe & Foundry Co.
American Locomotive Company.
American Steel Foundries.
Anchor Packing Co.
Angus Sinclair Company.
Ashton Valve Company.
Barco Brass & Joint Company.
Bettendorf Co. (The).
Bronze Metal Co.
Buda Company.
Chicago Car Heating Company.
Chicago Pneumatic Tool Company.
Crane Company.

Commercial Acetlyene Ry. Light & Signal Co.
Dearborn Chemical Company.
Detroit Lubricator Company.
Dickerson Mfg. & Supply Co.
Equipment Improvement Company.
Emery Pneumatic Lubricator Company.
Elgin National Watch Company.
Franklin Railway Supply Company.
Galena-Signal Oil Company.
Garlock Packing Company.
Gold Car Heating & Lighting Company.
Green Tweed Company.
Harry Vissering Co.
Hunt-Spiller Mfg. Co.
H. G. Hammett.
H. W. Johns-Manville Company.
Internaticnal Correspondence Schools.
Jacobs-Shupert Fire Box Co.
J. Rogers Flannery & Co.
Joseph Dixon Crucible Company.
Jerome Edwards Metallic Packing Company.
Jenkins Brothers Company.
Jerguson Mfg. Company.
Keystone Lubricating Company.
Leslie Company.
Locomotive Stoker Company.
Liberty Manufacturing Company.
Locomotive Superheater Company.
McCord & Company.
Manning, Maxwell & Moore.
Mark Manufacturing Company.
Monthly Official Railway List.
Mudge & Company.
Moon Manufacturing Company.
Nathan Manufacturing Company.
National Boiler Washing Company.
National Graphite Lubricator Company.
National Tube Company.
National Malleable Casting Co.
National Railway Devices Co.
New York Air Brake Company.
Ohio Ejector Company.
Okadee Company.
O'Malley Beare Valve Company.
Pyle-National Electric Headlight Co.
Parsons Engineering Company.
Parkersburg Iron Company.
Paxton, Mitchell Company.
Pilliod Company.
Railway Age Gazette.
Railway List Company.
Railway Master Mechanic.
S. F. Bowser & Co. (Inc.)
Stores Mica Company.
Strong, Carlisle & Hammond.
Syracuse Faucet & Valve Company.
Standard Heat & Ventilating Company.
Talmage Mfg. Co.
Tom Brown & Company.
U. S. Metallic Packing Company.
Universal Flexible Packing Company.
W. H. Miner Co.
Watson-Stillman Company.
Wm. Sellers (Inc.)
Westinghouse Air Brake Company.
Worth Bros Co.

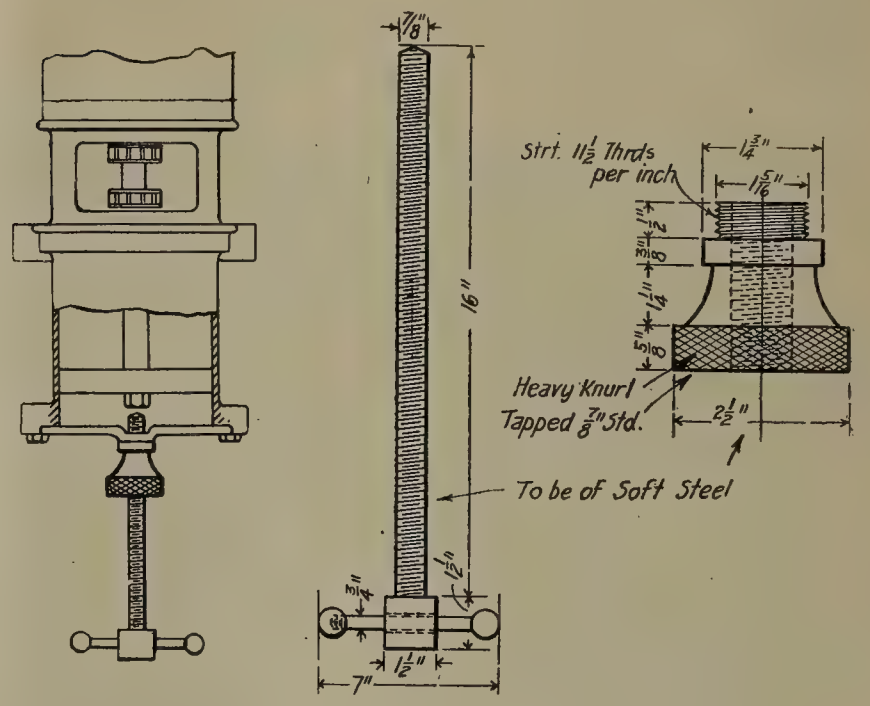
The American Railway Safety Association will hold a meeting at the LaSalle Hotel, Chicago, on September 22, to perfect its organization. A. W. Smallen of the C. M. & St. P. is temporary chairman.

PISTON HOLDING DEVICE.

By F. W. Bentley, Jr.

The removal of the reversing rod of the Westinghouse 9½-inch pump on engines in the roundhouse is often hampered and made difficult by the inclination of the main piston with its two heads to drop to the limit of the down stroke, and also to stop at the above named point when the operating steam is shut off from the boiler.

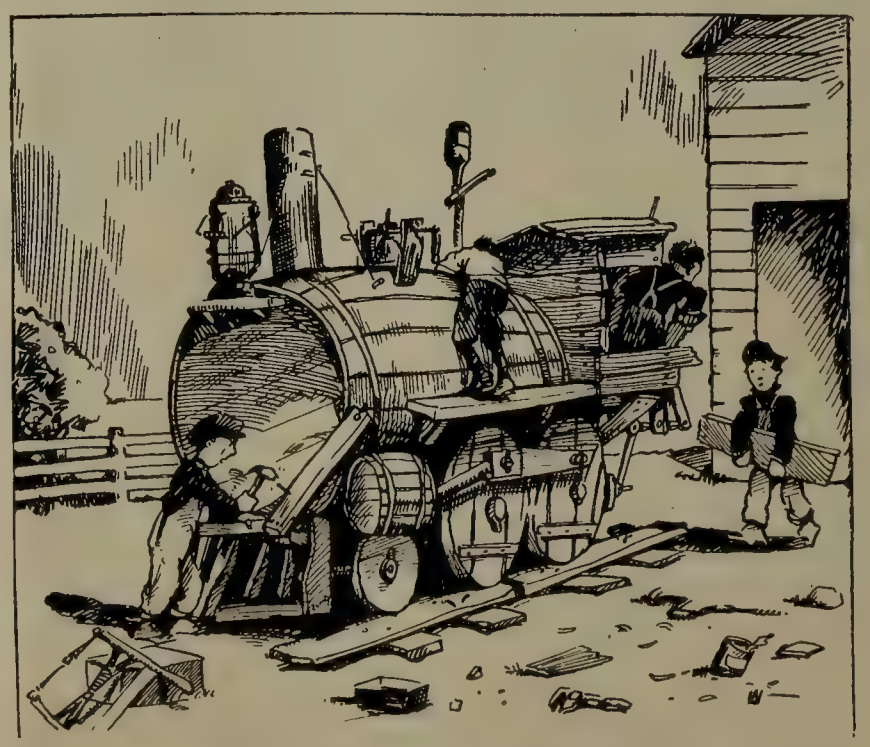
Tight piston packing and dry cylinder walls will then make it sometimes almost an impossibility to raise the piston and rod without the removal of the lower air cylinder head.



Piston Holding Device.

The sketch shows a hollow plug threaded to screw into the lower air cylinder head at the opening filled by the No. 112 bottom plug. The jack rod or screw passing through the plug strikes the lower end of the piston and makes it possible to easily spot the piston no matter how tight the same may be in the cylinders or held by the piston packing.

An assembly of the arrangement is also shown in the illustration. A device of this nature will soon save the cost of its construction by making it possible for the machinist to raise easily any piston without a removal of the head.



The Engineer of Tomorrow.

(From Power)

System as Applied to Shop Repairs to Locomotives.*

By A. H. Kendall, Foreman Erecting Shop, C. P. R. Angus Shops, Montreal.

As I realize the immense scope of this subject, it is not my intention to recommend any detailed or general principle in the handling of repairs, but rather to give a resumé of the general system which is more or less in vogue at the Angus shops of the Canadian Pacific, together with some of the impressions which I have received from my study of the subject, both from personal observation and otherwise, and to induce a discussion which may prove both instructive and beneficial to those who are interested in the efficient handling of shop repairs to locomotives.

Apart from the financial gain in the systematizing of a repair shop, the aim is to get a team-like organization which is physically and intellectually fit to perform the ordinary duties that are required, as accurately as necessary, and with little or no delay, and to be sufficiently flexible to comply with the extraordinary conditions which from time to time occur, with the least possible friction and, generally speaking, to be there with the goods, no matter what the requirements of the road department may be.

The success of such an organization depends more or less upon the opportunities it is given to prepare to meet the requirements, and to know what the requirements are, and will be, with respect to anticipated repairs to locomotives, so that a staff may be trained and maintained without undue fluctuation. This may, generally speaking, be very materially assisted by the systematic shopping of engines, and the divisional master mechanic having condition records at hand at all times, should endeavor, as far as possible, to do his part of the team play by turning in for repairs each month a certain percentage of the locomotives under his control, such percentage to be that which will maintain the power in a good serviceable condition.

The ideal state of affairs exists at the shop when engines are coming in for repairs in a constant flow from month to month, rather than a spasmodic shopping of say 5% one month and 20% the following month, and as there is a ratio between the number of locomotives in service and the number requiring repairs each month, which will give the most efficient results, it seems to me, from a shop point of view, that this ratio should be fixed and maintained as far as possible, so that any system which may be set up in the shop could be carried through to the best advantage.

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* A paper read before the Canadian Railway Club.

The repair record, Chart No. 1, shows the total repairs per month from the various shops for the Canadian Pacific, Eastern Lines, and embraces a period of three years. The upper line shows the number of locomotives receiving general or No. 1 and No. 2 repairs, while the lower line shows the number of locomotives receiving No. 3 or specific repairs. The straight line shows the average number of No. 1 and No. 2 repairs required per month to give the same total output for the three years recorded.

The upper line of Chart No. 2 shows the total general or No. 1 and No. 2 repairs per month turned out of Angus shops for Eastern Lines for the same period of three years, and the lower line shows the average cost of labor per engine per month, while the straight line shows the monthly average that would give the same total output for the three years recorded.

This comparison would serve to show the effect on the cost per engine, caused by the fluctuation of output, as it shows that the higher the output the lower the average cost, and that the lower output would average a higher cost per engine. Other records, however, show that the nature of repairs in January, 1911, was very much heavier on account of there being a much greater percentage of rebuilds than in May, 1910, also that this is more or less true when comparing any of the large and small monthly outputs; consequently, the great fluctuation of average cost is not altogether due to the fluctuation in numbers of monthly output.

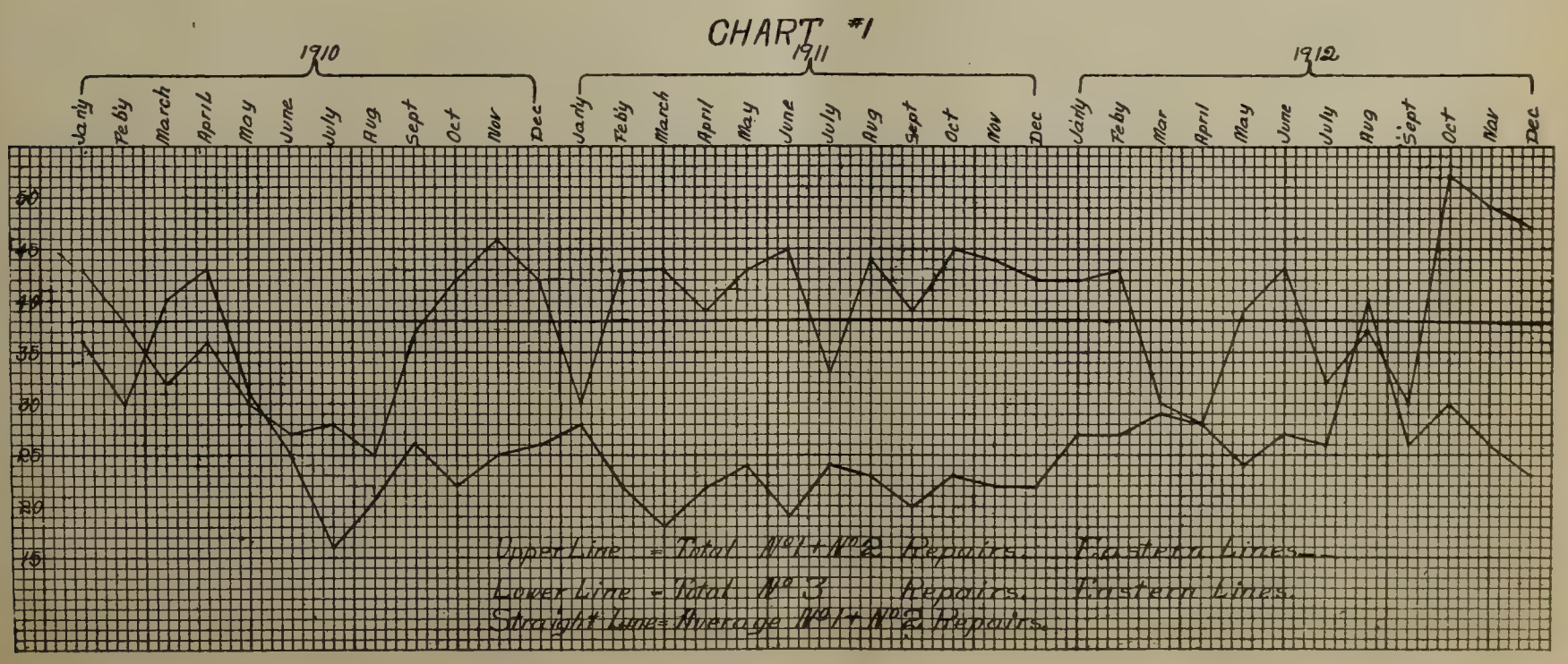
I am, however, convinced that with a more systematic shopping, which would permit of a more uniform output, to follow the average line more closely, the cost line would also straighten out and run more nearly parallel with the output line, and also show a very material decrease in cost for the yearly average per engine repaired.

Anticipation of Repair.

On the Canadian Pacific the general master mechanic's office prepares a monthly statement for the shop, which gives the number of locomotives expected to be shopped from each division during the following month. This report gives the classification and engine number of each locomotive, and gives a general classification of repairs, and also shows in a general way the chief cause for shopping the engine.

This gives the shop a line on what to expect, and gives warning so that the necessary organization can be arranged for.

The classification of repairs is governed by maintenance regu-



lation card No. 99 M R 2, which reads as follows and needs no explanation:

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99 M R 2.

Issue to a. d. c. e.

CANADIAN PACIFIC RAILWAY.

All Lines.

Motive Power Department.

Maintenance Regulation 99 M R 2.

Classification of Locomotive Repairs.

Issue No. 3, July 20, 1910.

1.—Repairs to locomotives to be sub-divided as follows:—
Wreck repairs.
Defect repairs.
Running repairs.
Shop repairs.

2.—Wreck repairs, to be designated by the letter "W," are those due to accidents and collisions and do not include the cost of replacing defective portions of the engine unless connected with accident or wreck.

3.—Defect repairs, to be designated by the letter "D," are those necessitated in replacing broken or defective parts when not accompanied by wreck or accident.

4.—Running repairs, to be designated by letter "R," are repairs other than wreck or defect on which the estimated cost of labor at one shopping does not exceed $100.00. If tires are changed or turned when engine receives running repairs they will be designated as R. T.

5.—Shop repairs, to be designated by specific numbers, are repairs other than wreck or defect, on which the estimated cost of labor exceeds $100.00.

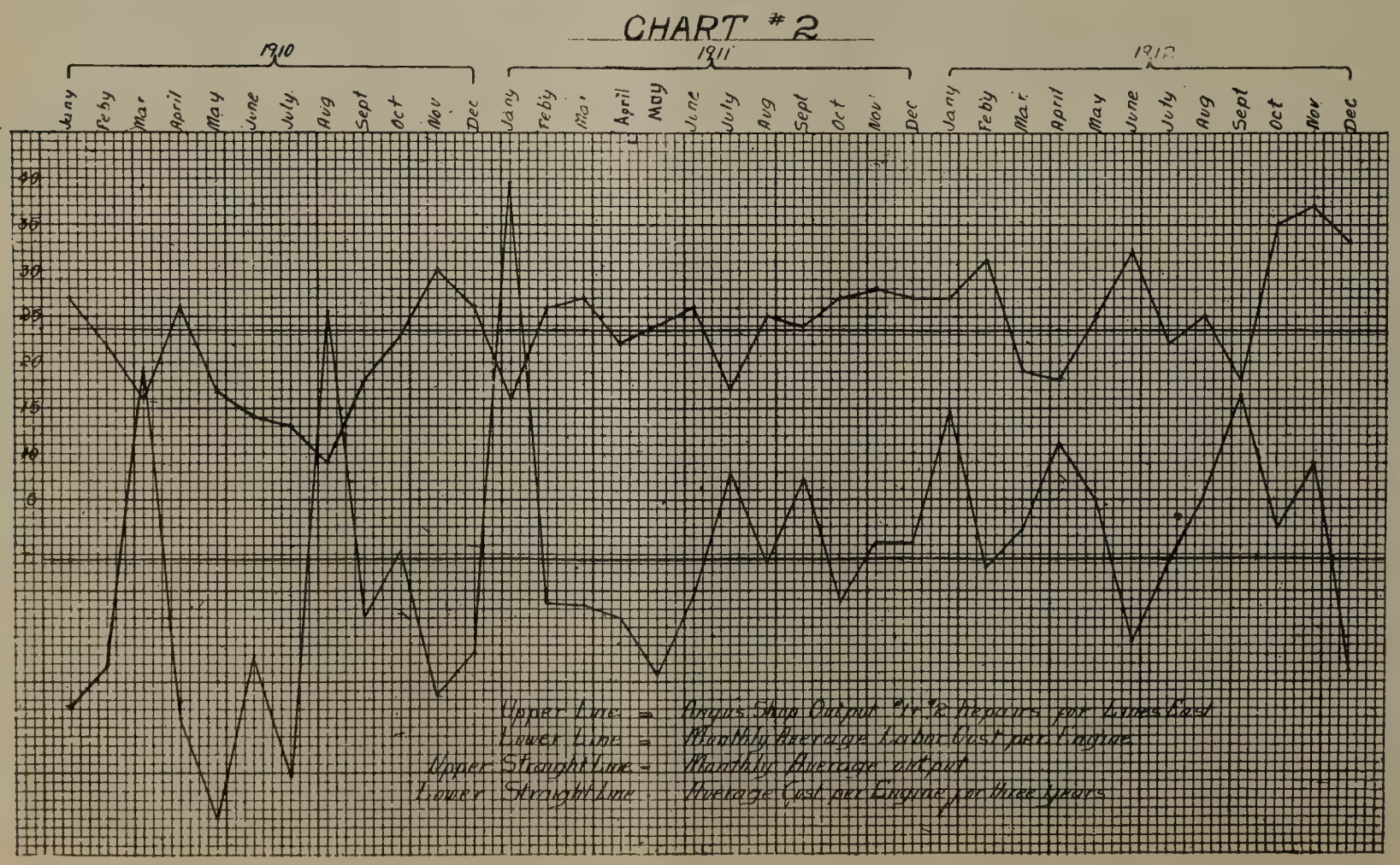
Shop repairs are designated by number according to the amount of work done: 1st, on machinery; 2nd, on tubes; 3rd, on firebox, as follows:—

Machinery Repairs	No. 1	General repairs to machinery with tires turned or changed.
	No. 2	Light repairs to machinery with tires turned or changed.
	No. 3	Light repairs to machinery with tires not turned or changed.
Tube Repairs	No. 1	Tubes removed and reset.
	No. 2	Tubes part removed and reset; if less than 10 per cent of tubes are removed it shall not be considered a repair.
Firebox Repairs		Are specified by number of sheets applied; two half sides equal one sheet.
Conversions or Rebuilds	C	When converted from one type to another.
	B	When receiving new boilers without conversion.
	B C	When receiving new boilers and converted.

6.—Form M. P. 19 to be made out for R. T. and Form M. P. 18 and 19 for all other shop repairs.

A detailed repair report of each engine should follow this general statement as early as possible, and never later than one week previous to shopping. It should be made out by the locomotive foreman in charge, or other competent person who is thoroughly in touch with the actual condition of the engine, and should outline very clearly the exact nature of the repairs required to the machinery and boiler, so that the shop would be in a position to take advantage of this knowledge by arranging for the preparation of parts for extraordinary work of any nature. This would decrease the number of days the engine would be out of service, and likewise avoid the unnecessary delay which would consequently follow, if shops were not provided with means to anticipate the requirements. This report should particularly cover the defects peculiar to actual service which might not be found, even by most rigid test or inspection in the shop, and so pass uncared for.

Attached to this repair report, or supplementary to it, should be a statement showing any missing parts which may have been destroyed by accident, or have been robbed en route for "repairs to other engines," and should detail the method of shipment of defective parts, and advise whether any material is being shipped or not. It should also give detailed distribution of robbed parts so as to eliminate the extra cost to the engine being shopped, due to the manufacture of parts not required, and to the manufacture of the necessary new parts to replace



No. 1 Repair — MACHINE SHOPS — *Schedule No. 1*

Days in shop	ERECTING SHOP	BOILER SHOP	SMITH SHOP	BRASS	EAST MACHINE	WEST MACHINE	SPRING AND BRAKE	TANK SHOP	CARPENTERS'	PAINTERS'
1	Eng. in shop Eng. off wheels Stripped for test Smokebox front off									
2	Stripping compld. Inspector's report in	Staybolts tested						Ashpan down		
3	New parts ordered All rep. mat. sent to Mach. Shop Cyl. and val. bushes out Boiler work started							Tender stripped Tank lifted for repairs	Tender trucks stripped Wheels delivered to Machine Shop	
4	Cyls. off and deld. Frames off and deld.	2" Tubes out								
5	Cyls. patched	5" Tubes out								
6			Motion work Frames					Tank finished	Trucks finished Tender trucked	
7	Repair Cyl. and Valve Bushes bored	2" Tubes welded 5" cut and rumbled	Spr. and Brake gear fin. Splices, Tail bar fin.						Tender finished	
8	Cyl. Covers ground	5" Tubes to S.S.	Main and side rods	Turret valves	Expansion brkts. Cyls., frames Deck castings					Tender finished
9	Frames bolt., cyls. set Widths furnished Binders up	5" Tubes cut and tested			Cyl. bushes and val. Shoes and wedges Top splices	Motion plate or cross tie Guide bars	Runboard brackets			
10	New Valve or Cyl. Bushings in Shoes and Wedges laid off Motion plate up	Tubes in boiler		Boiler mtgs. Pressure guages Throttle gear	Buffer casting Bk. val. covers Crossheads	Dry pipe, eccentrics Pillars and fillers Stand pipe, domepot		Exp. and waist sheets		
11	Guides and Crossheads lined Boiler work finished Buffer beam up	Boiler tested			Centre casting Wheels	Motion and valves	Springs and gear	Cab plates Runboards		Frames pained
12	Mot. hung, spr. gear up Eng. wheeled				Sandboxes Headers Ft. cyl. covers	Bell stand	Supfitr. damper gear E. T. Brake gear	Cab	Cab wdwrk. finished	Boiler painted
13	Headers in				Steam pipes Smokestack base	Main rods	Brake gear Pump brackets Ashpan gear		Boiler lagged	
1	Motion finished Headers tested Under-hung spr. finished			Damper cyl	Exh. pipes, radial truck stays and plates Smokestack Smokebox front	Cyl. cock gear	Coupler casting Firedoor Grate shkr. gear Whistle rigging	Ashpan Lamp and Dynamo board Deflector plates	Runboards and buffer beam up	
15	Valves set, brake gear up Steam and exh. pipes in		Pilot stays Cab handrails	No. and class plates Metallic packing	Pistons, casings Truck Friction gear	Side rods				
16	Rods on and trucked Pistons in	Plates and netting in		Cylinder cocks Relief valves						
17	Light work and clipping finished	Ashpan up								Engine finished
18	Eng on trial									

N.B.—(1) When Boiler is new or requires New Fire Box or Greater Repairs it will be tested on the 28th day and follow on with above Schedule commencing with test date as above: 11th day.
(2) When Boiler has New Fire Box Sheets without new Crown Sheet it will be tested on 33rd day and follow on with above Schedule, commencing with test date as above: 11th day.

No. 2 Repair — MACHINE SHOPS — *Schedule No. 2*

Days in shop	ERECTING SHOP	BOILER SHOP	SMITH SHOP	BRASS	EAST MACHINE	WEST MACHINE	SPRING AND BRAKE	TANK SHOP	CARPENTERS'	PAINTERS'
1	Eng. in shop and off wheels Strip for test, smokebox off									
2	Stripping completed Inspector's report in	Staybolts tested								
3	New parts ordered All rep. material sent to Machine Shops Cyl. and valve bushes out	Boiler work started							Tender trucks stripped Wheels delivered to Machine Shop	
4	Frame or Cylinder off	2" tubes out								
5		5" tubes out	Mot. work finished Frames					Tank finished	Truck finished	
6			Spr. and brake gear Tail bar and splices						Tender finished	
7		2" tubes welded 5" tubes rumbled	Main and side rods	Turret valves	Frames, cyls., exp. brkts. Deck casting Waist sheet crosstie Frame stay					
8	Frames up, Cyls. set Deck casting in Widths and binders up	5" tubes to S.S. (Smith Shop)		Boiler mountings	Box sizes, cyl. and valve bushes Brake cyl. heads Guard stays, top splices Rbrd. brkts. Shoes and wedges	Guides, rev. lev. fulc. Motion plate Guide yoke knees Motion crosstie	Rbrd. brkts.			Tender painted
9	Shoes and wedges laid off Boiler set, Mot. pl. up Exp. and waist sheets up	5" tubes cut and tested Tubes in boiler		Throttle stuff box Top checks	Buffer casting Crossheads, steam chests Back valve covers	Domepot, dry pipe Eccentrics, motion and valves Pillars and fillers Stand pipes, tee pipe Throttle rod ends		Exp. and waist sheets		
10	Guides and Crossheads lined up Mot. hung Buffer beamp up	Boiler tested			Ashpan hoppers Center casting Ft. cyl. covers, sandbox Idler pedestals Suphtr. headers, wheels Truck brake gear	Bell stand	Springs and gear Suphtr. damper gear	Cab plates Runboards	Runboards Buffer beam	Boiler painted
11	Spr. gear up Eng. wheeled Mot. finished Headers in, boiler lagged			Damper cyls. Rel. vals	Exhaust pipe Radial truck stays St. pipes Smokestack and base Smokebox front	Cylinder cock gear Main rods Main rod safety hanger	Brake gear Pump brkts. Ashpan gear	Ashpan	Cab	
12	Valves set. Brake gear up Headers tested Steam and exh. pipes in		Cab hand rails Pinlifter Pilot stays	No. and class plates	Pistons Friction gear Casings Pistons	Side rods	Coupler casting Firedoor Whistle rigging Grate shaker gear	Lampboard Lampboard brkts. Dynamo board Dynamo brkts. Deflector plates	Boiler lagged Pilot	Engine painted
13	Plates and netting in Rods on and trucked Clipping finished									
14	Eng. bokked out and on trial									

those robbed for other engines, and which should be charged to the engine on which they were used.

A tool list is sent in with each engine, so that on arrival the shop hostler may check with the messenger in charge, and arrange to care for the equipment by either renewal or repairs. The shop is provided with maintenance regulation cards and manifests, governing all required repairs, and with change in progress sheets for each type of engine, which show the improvements or alterations necessary at each shopping. From this change in progress sheets in conjunction with the repair report, the whole is subdivided in detail for the guidance of each department, so that each may do their share by preparing any new parts that may be necessary, or by arranging for any extraordinary repairs that might cause delay if not known.

The superintendent's office arranges for and authorizes the necessary debits and credits due to missing or scrap material.

Systematizing.

In repairing locomotives we will agree, no doubt, that any system which eliminates wasted effort is good. It does not necessarily follow, however, that because any particular system has been branded as scientific that the brand alone confirms it.

Conditions in different shops are so variable that an effective system adopted in one shop might be ineffective in another, consequently the best system to set up in any shop is that which, after careful investigation, will fill the required needs.

In generally considering a system from a shop point of view it seems to me that it might naturally be considered in the following parts:—Cutting out lost motion, and standardization of methods; regularity and uniformity of work; stimulation of workmen and coöperation or team play of all concerned; and routing material and repair parts.

At the Angus shops an inspectors' or demonstrators' department takes care of the standardization of machine operations and methods, and its general function is to make detailed study of the elements of every piece of work, for the purpose of discovering the best way of handling it, and to eliminate any unnecessary motion or work on the part of the operator, and to bring each machine up to its standard of efficiency, by attaining the speed and feed which will secure the highest and best possible production. Also to standardize the cutting tools to the correct angles and proportions, which the experience of the past and present has proved to give the best possible results.

A portion of the tool shop is set aside for the care of all cutting tools throughout the shop, and a liberal stock of all classes of standard cutting tools is kept on hand in proper condition.

Each machine is provided with a standard assignment of tools, and, as tools require grinding or redressing, they are taken away by a patrol messenger, who will replace them with other tools, and deliver the defective tools to the departmental tool-dresser, if the repairs are light, and from there to the tool shop if the repair is heavy. The tool-dressers of the several departments are specialists, and their time is devoted entirely to this work, with the consequence that all tools are maintained to very nearly the limit of effectiveness.

This system does away with the lost motion to the machine, due to the operator having to go to a distant tool room to exchange his defective tool, or by waiting his turn at the grindstone or emery wheel to make the repair.

In considering the subject of detail operation, it seems to me that the leader or officer who sneers at the mention of motion studies, is very far behind the procession of today, and very likely this same man would cross corners to take a short cut home, or kick at a car transfer point, when the connection is not made promptly.

It is simply a matter of every day common sense to take the short cut in saving work, and we should consider it from the point of view that practically every man in the shop is doing the same work day after day, and if he loses even a few minutes on one operation, that few minutes will grow into hours and days, just in like proportion to the number of operations performed.

There is an easiest and quickest way to perform every work operation on a locomotive repair, and that is the way we should be out to find by the application of deliberate and diligent study, and by analyzing the methods of various other shops, and by the comparison of operation by operation and their results, with those of other roads, instead of leaving the workmen to the old hit or miss principle, or to the old time hidebound traditions which suggest we have always done it this way and will continue to do so.

The elimination of unnecessary motion in doing any work is always a benefit, because it conserves the vitality of the workman and makes his labor more productive. Apart from the machine operations it is the duty of each foreman to observe the methods of his workmen with a view of correcting any improper method and removing any unnecessary motion in his work; this is particularly true where inefficient men are only obtainable to do skilled work, and it becomes necessary to study their movements in order to train them to that standard of efficiency which skilled men have already attained.

A straight piecework basis is used at the Angus shop as a stimulus to the workmen, and by this means an efficient worker is able to increase his earning capacity considerably above his day rate without fear of overstrain, providing he apply himself diligently to his duty, and that he is supplied with continuous work. My experience is that the average mechanic of today, particularly those with whom I am in daily touch, are never lacking in stimulus and are willing to go the whole way, or in other words, willing to go continuously to the healthy limit, provided care is taken to supply them work in a reasonably uniform manner, so that their efficiency will result in financial gain. Consequently, it has been found that where overdraws, or loss of contract money occurs, it is usually due to the fact that the supply of work has not been of a sufficiently uniform character or that work has been delayed by some other department. Where it is due to inefficiency, greater attention is given to the education of the workman, and where possible, work is assigned to him that would make him more or less of a specialist, in a given line that is congenial to him. This applies particularly where it becomes necessary to employ men who are not familiar with the class of work required of them.

The piecework is detailed as much as possible, so that where more than one operator is called upon to work on the same job, each is paid for the portion he may do, and by this means the efficient man does not lose by the inefficiency of another.

A hearty spirit of coöperation is maintained throughout the works between the working force and the management by continued effort on the part of those in charge, to deal with the workmen in an open, frank and candid way, affording the fullest opportunity for consultation and explanation, in advance of any action which may materially affect their interest. To further the development of esprit de corps amongst the workmen, the management have fostered and instituted a scientific and literary association, and an amateur athletic association, which embraces nearly all competitive sport common to our country. These societies are controlled and managed by the employees themselves, and have become a powerful link in uniting all grades in a common interest, and have been productive of much good in this way, as well as by physically developing the younger men and others who may be in need of such, to further fit them for the duties they are required to perform through life.

The routing of work in all large shops is a very live subject, and it is one that may either cause a great deal of annoyance or otherwise, dependent entirely on the method adopted and carried out. The routing trouble at Angus has been more or less overcome by the careful grouping of machines, so that as far as it is practicable, all work required on any particular part will be done within as small an area as possible, and under the same leader. Where it becomes necessary for work to go to more than one shop, the foreman who last handles a part is responsible for its delivery to the next in order, and where delay occurs it is shown up quite clearly by the material chasing schedule or the

work order system, which is taken care of by a scheduling department.

Scheduling Repairs.

The duty of the schedule department is to provide each department each day with a detail of all work required from them for the day, and to show up clearly to all in charge any work or operation which may require particular attention on account of it being neglected or held up for lack of material. This information is taken from and governed by a master schedule or key, which was drawn up some years ago, and which has been more or less revised after careful and intelligent consideration to meet the requirements of the Angus shops, and it is, generally speaking, an up-to-date common sense method or system of material chasing.

Schedules.

Schedule No. 1, as shown, is used as a guide for providing detail operation sheets for all No. 1 repairs, including rebuilds and firebox work.

Schedule No. 2 is used as a guide in preparing detail operation sheets for all No. 2 repairs of locomotives.

On arrival at the shop, the inspection staff, who should have already been supplied with an outside repair report, go over the engine in a general way, and any work which may be of a doubtful nature in accordance with the report is forthwith decided and any further material required is immediately ordered.

When the engine is shopped, the classification of repairs having been thoroughly decided, the stripping gang, who are specialized in this particular branch, remove all parts first which are necessary to permit of any further inspection or test required.

Testing and detail inspection is then made, and orders issued for the balance of the stripping, which is based entirely on the individuality of the engine being stripped. Indiscriminate stripping should not be tolerated, and care should be taken that no part is removed unless it requires attention or which must be removed to permit of repairs to some other part. The chargeman should pay particular attention to the recording of all parts requiring repairs, especially the detail, or those parts which are usually considered unimportant, so that every piece which is for distribution or renewal will be duly ordered on the schedule office, who in turn order on the various feeder shops, so that continuous record of its progress through the shop may be obtained at any time and duly entered on the morning operation sheets, to assure the proper attention being applied towards having it returned in due time along with the more important parts for assembly.

The daily operation sheets, copies of which are shown, as supplied the erecting shop and the wheel shop, should be given to the foreman of each department at 7 o'clock or immediately at the starting hour, so that there will be absolutely no delay from this source, and so that the work may be advanced and completed in the order in which it is really required.

This sheet is made out in sufficient copy to provide the various leading hands with a list of work required for the day

Operation sheets for all departments are similarly drawn up, but with the detail to suit the requirements, as experience teaches the necessity.

The foreman of each department is expected to go over this sheet, item for item, with his leading hands, and assure himself that the proper attention is being given to each piece in progress, and to make report to superintendent's office of any material for which he may be held up from outside firms, particularly steel and iron, malleable and brass castings, and any other parts which are not manufactured in the plant.

CANADIAN PACIFIC RAILWAY COMPANY.
Angus Shops Schedule Office.
Erecting Shop Operations.

WEST ERECTING SHOP:
GANG NO. 1.

523	Guides and Crossheads lined up	2x	Top rails late
	Motion hung	x	
	Spring gear up	x	
	Engine wheeled		
	Headers in		
	Boiler lagged		
	Ashpan up		
1499	Plates and netting in	x	
	Rods on	x	Side rods late
	Engine trucked	x	Truck late
	Light work finished		
3410	Guides and crossheads lined up	x	Crossheads late
		x	Boiler works late
	Boiler test		
	Motion hung		
	Spring gear up		
298	Widths furnished		

GANG NO. 2.

1000	Plates and netting in	x	Application of experimental front end
	Rods on	x	
	Engine trucked	x	
	Light work finished	x	
	Engine on trial		
950	Motion finished	2x	Main rods late
	Grates in	2x	
	Valves set	x	Main rods late
	Brake gear up	x	
	Dump gear up	x	
	Plates and netting in		
	Rods on		
	Engine trucked		
3489	Boiler test	x	Boiler work late
	Motion hung		
	Spring gear up		
	Engine wheeled		

EAST ERECTING SHOP:
GANG NO. 3.

1730	Plates and netting in	x	
	Rods on	x	
	Engine trucked	x	
	Light work finished		
754	Boiler test	x	Boiler work late
	Motion hung		
	Spring gear up		
2649	Widths furnished	x	Cylinder late
	Shoes & wedges laid off		

GANG NO. 4.

545	Widths furnished		
402	Plates and netting in		
	Rods on		
	Engine trucked		
478	Boiler lagged	x	Boiler work late
	Ashpan up	x	
	Motion finished		
6184	Widths furnished	2x	
	Shoes & wedges laid off	x	
	Guides and crossheads lined up		
	Boiler test		

CANADIAN PACIFIC RAILWAY COMPANY.
Angus Shops Schedule Office.
Wheel Shop Operations.

545 x Boxes and Eccentrics on Axles and Wheels delivered

298 x Tyres turned, Boxes bored and faced
Hubs face, Pins turned, Boxes assembled

2694 xx Tyres turned, Boxes bored and faced
x Hubs faced, Pins turned, Boxes assembled
Boxes and Eccentrics on Axles. Wheels delivered

370 x Liners on Boxes
x Journals turned, Boxes planed
Tyres turned, Boxes bored and faced

647 Journals turned, Boxes planed
Tyres turned, Boxes bored and faced
3524 xx Wheels in shop and inspected
x Brasses in Boxes
Liners on Boxes

2580 x Brasses in Boxes
Liners on Boxes

1756 x Brasses in Boxes
Liners on Boxes

6162 x Wheels in shop and inspected

3527 Wheels in shop and inspected

A general progress sheet, copy of which is here shown, is supplied to the management of the shop. This shows, in very compact form, the general nature of the supply, and is kept fully posted by being checked daily with the operation sheets, so that delinquents can be located at a moment's notice, without the necessity of referring to the detail operation sheet.

LOCOMOTIVE DEPARTMENT.

ANGUS SHOPS
Progress Sheet
SUPT OFFICE 2-9 1913

Foreman _____

Engines must leave Shop on dates shown below.

Division	Eng No.	Mch	T	FB	In Shop	Schedule Date Out	Machine Shops. X	BM	Sp	M	W	R	BK	Trk	Tubes. 5" Out	5" W'ld	2 1-4" Out	2 1-4" W'ld	O. K.	Tender Shop In	Tank	Trk	Remarks
E.	1703	1	1		1-23.	2-10.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
O.	950	1	1	1	1-8.	2-11.	✓	✓	✓	✓	✓	✓	✓		+	+	✓	✓	✓	✓	✓	✓	
E.	478	1	1	4	12-30.	2-12.	✓	✓	✓	✓	✓	✓	·		+	+	✓	✓	✓	✓	✓	✓	
E.	523	1	1	4	1-14.	2-12.	✓	✓	✓	✓	✓	✓	✓	✓	+	✓	✓	✓	✓	✓	✓	\	
O.	693	3	1	1	1-29.	2-13.	✓	+	+	+	+	+	+	✓	✓	✓	✓	✓	✓	✓	✓	\	
L,S.	3489	1	1		1-20.	2-14.	✓	✓	✓	✓	✓	\	✓		✓	✓	✓	✓	\	✓	✓		
O.	754	1	1	4	1-3.	2-14.	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓		
E.	6184	1	1	3	1-15.	2-15.	✓	✓	✓	✓			✓		+	+	✓	✓	✓	✓			
L,S.	3410	2	2	V	1-25.	2-15.	✓	✓	✓	\	✓				✓	✓	✓	✓		✓			
E.	2649	1	1		1-27.	2-17.	\	✓	✓						✓	✓	✓	\		✓			
A.	545	1	1		1-23.	2-18.	\	·	✓						+	+	✓	\		✓			
L,S.	3434	3			2-7.	2-18.	✓	+	·	+			+		+	+	+	+	+	✓			
O.	2694	1	1	V	1-24.	2-19.									✓	\	✓	\		\			
L,S.	2580	1	1		2-4.	2-20.									✓	·	✓			\			
E.	298	1	1	4	12-23.	2-20.		✓							+		✓						
E.	647	1	1		2-3.	2-21.									✓		\						
O.	370	1	1		2-5.	2-21.									+	+	✓						
E.	1756	1	1		2-6.	2-22.									✓		✓						
E.	1505	1	1	5	2-3.	2-24.									+		✓						
A.	3525	1	1	3	1-25.	2-25.									✓		✓						
O.	6162	1	1	4	1-8.	2-26.									+	+	✓						
E.	3527	1	1	2	1-28.	2-27.									✓	·	✓						
O.	825	1	1	1	1-20.	2-27.									+		✓						
L,S.	3363	2			2-12.	2-28.																	
E.	552	1	1		2-13.	3-1.																	
O.	113	1	1	NB	2-4.	3-3.																	

This sheet shows the engine number, classification of repairs, the division to which the engine is assigned, and the date the engine is taken into shop and expected out, and also a resumé of all work which has been completed. The letters above the several columns under machine shop represent the parts—guides and crossheads, boiler mountings, spring and gear, motion and valves, wheels, main and side rods, brake gear, engine truck—while the tick mark is merely an abbreviated or shorthand method of showing that the work is finished.

For illustration: In the column X the downward line opposite engines 2649 and 545 indicates that the guide bars are complete, but not so the crossheads, while the complete ✓ without the extra cross line as shown opposite engine number 3434 would indicate that guide bars and crossheads are both ready, but not delivered, and the full figure indicates that the material is completed and supplied to the erecting shop. This applies throughout the whole sheet as required locally, and when a person becomes familiar with the schedule, this shorthand method is very quickly absorbed, and a glance at the sheet is sufficient to show where to expect delay.

A general operation and delay sheet is also supplied the management, and shows all material due to erecting shop, as well as any material which may be late, and gives the cause for delay when possible to do so. This gives immediate information to the seat of the trouble, and steps may be taken at once to rectify the cause, usually without further investigation.

By this means of checking material and work order there is no chance of failure to organization in any particular branch of the shop, as the unit which may be lagging can be straightened out at will, and brought to the required efficiency without any elaborate or delayed investigation, by merely comparing the piece work balance to see that the man efficiency is not falling behind. This, if carried out will bring about a well balanced team or organization, and get away from the unwholesome deal of any one feeder shop falling down and dragging the whole organization back with it.

In considering the schedule it should be remembered that it is better to have finished parts lay unusued one or even two days than have erecting shop delayed half a day for the want of it, and for this reason some latitude should be allowed to overcome those little hitches which will occur even in the best regulated families, and as "the best laid plans of mice and men gang aft agley," it is sometimes necessary, on account of some ungovernable delay, to make a very short schedule for one or more engines, to keep the output up to requirements, and a change might be necessary at any time to meet the urgent or extraordinary cases which occasionally occur on account of road conditions.

In the case of heavy boiler work, the boiler is removed from the frames as per schedule and carried to the boiler shop.

All other material is loaded on the frame and put out in storage until a certain stage is arrived at in the repair of the boiler, at which point the engine is again brought into the shop and the stripping completed, so that all material may be delivered to the feeder shops for repairs at the correct time, to allow the work on all parts to progress in harmony, and the frame being ready to receive the boiler at test date, the operations will follow as in the case of an ordinary repair.

The boiler schedule, of which is here shown a sample, is based upon extensive observations of actual performances, and sufficient data has been collected to permit of a suitable schedule being prepared for any class of repair, or any type of boiler. Consequently, the full extent of repairs to an engine and boiler being known, an accurate estimate can be made of the number of days that will elapse before the engine will be ready for service.

C. P. RY. ANGUS SHOP

Job: New Firebox & Roundhead. **Eng. No.———**
Class———

No. of days, 28, **Boiler Schedule**

Date	Day No.	Schedule	Remarks
	1	Engine in shop	
	2		
	3		
	4	Boiler to boiler shop	
	1	Drill staybolts	
	2	Drill staybolts	
	3	Drill Crown	
	4	Drill Crown	
	5	Cut out seam and mudring rivets	
	6	Tube sheet out	
	7	Side sheets out	
	8	Back out	
	9	Crown sheet out	
	10		

11 New sheets ready R. H. out
12 Build box
13 Hang sides and crown
14 Hang tube and back
15 Close corners. New R. H. ready
16 Rivet mudring
17 Caulk mudring
18 Rivet back sheet
19 Rivet seams
20 Rivet tube sheet
21 Start staybolting. R. H. in
22 Staybolts in
23 Staybolts cut. R. H. rivetted
25 Staybolts in
26 Rivet crownbolts
27 Staybolts and crownbolts O.K.—Tubes in
28 TEST

Cases will arise where the preliminary examination will fail to reveal all defects, and after the anticipated amount of stripping has been completed, if further repair should be found necessary, the schedule will immediately be rearranged to cover additional work.

A key or repair engine output sheet, as shown below, is used as a convenient form of arranging the schedule to obtain properly balanced results from each gang, and to maintain a regular output from the shops so that congestion will not arise in any one gang or at any particular period during the week or month.

ANGUS SHOP—Repair Engine Output

No. 1 Date	No. 2 Date	Date Out	Day	Gang 1.	Gang 2.	Gang 3.	Gang 4.
21	25	10	Monday	—	—	1730	—
22	27	11	Tuesday	—	950	—	—
23	28	12	Wednesday	523	—	—	478
24	29	13	Thursday	—	—	693	—
25	30	14	Friday	—	3489	754	—
27	31	15	Saturday	3410	—	—	6184
28	1	17	Monday	—	2649	—	—
29	3	18	Tuesday	3434	—	545	—
30	4	19	Wednesday	—	—	—	2694
31	5	20	Thursday	298	2580	—	—
1	6	21	Friday	—	—	642	—
3	7	22	Saturday	—	—	—	370
4	8	24	Monday	1505	1756	—	—
5	10	25	Tuesday	—	—	3525	—
6	11	26	Wednesday	—	—	—	6162
7	12	27	Thursday	825	3527	—	—
8	13	28	Friday	—	—	3362	—
10	14	1	Saturday	—	—	—	552
11	15	3	Monday	113	1005	—	—
12	17	4	Tuesday	—	—	261	—
13	18	5	Wednesday	—	—	—	—
14	19	6	Thursday	—	—	—	—
15	20	7	Friday	—	—	—	—
17	21	8	Saturday	—	—	—	—
18	22	10	Monday	—	—	—	—
19	24	11	Tuesday	—	—	690	—
20	25	12	Wednesday	—	—	—	—
21	26	13	Thursday	—	—	—	—
22	27	14	Friday	—	—	—	—
24	28	15	Saturday	—	—	—	—

Column No. 3 of this sheet shows the outgoing date of the engine, while columns Nos. 1 and 2 show the corresponding incoming dates of No. 1 and 2 repairs respectively. The other columns show the gang distribution of engines which are already in the shop, and also those which it is proposed to take in during the following week.

From this sheet the bulk of work in any gang can be immediately gauged, and should a tendency to lag manifest itself from any cause, the balance can be adjusted by careful allotment in the nature of repairs.

Existing conditions being the sole governor of the output, this sheet is altered without hesitation to meet the requirements from time to time as occasion arises, and engines are set back or forward in accordance with their specific importance, so that at no time is the schedule allowed to throttle the output or delay any individual engine which may be especially wanted.

The real object in view is to arrange the schedule to supply whatever the requirements may demand, and at the same time to give uniform and constant output.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.

The twenty-first annual convention of the International Railroad Master Blacksmiths' Association, which was held in Richmond, Va., August 19, 20 and 21, was well attended and a number of important papers were read. W. H. Owens, master mechanic, Southern Railway, Manchester, Va., was present at the meeting on Wednesday and gave a short address.

E. J. Hoskins, (L. S. & M. S.) read a paper on "Flue Welding." Jos. Grine (N. Y. C. & H. R.) read a paper on "Electric Welding." Other subjects discussed were "Tools and Formers," "Drop Forging," "Spring Making and Repairing," "Piece Work," "Case Hardening," and "Heat Treatment of Metals."

The following officers were elected for the ensuing year: H. E. Gamble, Pennsylvania Railroad, Altoona, Pa., president; T. F. Buckley, Delaware, Lackawanna & Western, Scranton, Pa., first vice-president and T. E. Williams, Chicago & North Western, Chicago, Ill., second vice-president. The executive committee is composed of J. P. Sullivan, chairman; T. F. Keane, Fred Norris, J. F. Keller and F. F. Hoeffle. The executive committee was instructed to choose from Denver, Milwaukee and Buffalo for the place for next year's convention. The report of the secretary showed that there are 244 active, 25 associate, and 8 honorary members.

SEVENTY-TON QUADRUPLE HOPPER CARS.

A lot of eighty hopper cars of seventy tons capacity was recently received by the Birmingham Southern. These cars were designed and built by the Pressed Steel Car Company and a description of them will, no doubt, be of considerable interest at this time, when the various railroads of the country are so seriously considering the use of larger equipment with the view of reducing the cost of transportation and maintenance.

It will be noted from the illustration herewith that the Birmingham Southern car has coke racks extending entirely around the sides and ends, these being made of 2½"x2½"x¼" angles, but cars of this kind can of course be built with solid sides and ends; in fact, some of the railroads have purchased in the last few years a great many cars of this general type for the transportation of coke, the bodies being made sufficiently strong so that if desired they may later on be equipped with seventy-ton trucks.

The weight of the Birmingham Southern car is 58,600 pounds, 38,700 pounds being in the body and 19,900 pounds in the trucks. This is several thousand pounds heavier than would ordinarily be necessary for a seventy-ton car of ample strength, but these cars have been built to withstand very severe service. The cars have a capacity level full of 2,840 cubic feet and with ten-inch average heap of 3,157 cubic feet. The ratio of paying load to total weight of loaded car is 72½ per cent.

The general dimensions of the car are as follows:

Length over striking plates..... 41' 5"

Seventy-Ton Quadruple Hopper Cars, Birmingham Southern R. R.

Length over end sills	41′ 3½″
Length inside of car	40′ 0″
Distance from center to center of trucks	32′ 0″
Width over side stakes	10′ 1⅝″
Width inside of body	9′ 6″
Height from rail to top of coke racks	12′ 0½″
Height from rail to top of brake mast	12′ 9″
Length of drop doors in clear	about 33′ 6⅞″
Width of drop doors in clear	3′ 4¾″

The cars are equipped with sixteen drop doors operated by the "Lind" door gear, which is self-locking, and when the doors are closed the accidental discharge of lading is impossible. The total door area is 97 square feet.

The trucks are the arch bar type with 6"x11" journals, equipped with Reliance truss type bolsters, pressed channel type brake beams, rolled steel wheels and adjustable type side bearings.

The safety appliances are applied in accordance with Interstate Commerce Commission requirements. The air brakes are Westinghouse KD-1012 equipment and the cars are equipped with Westinghouse Farlow Draft Gear.

FEED VALVE REPAIRS.

By J. A. Jesson.

The drawings show tools and fixtures for repairing the regulating department of the slide valve, feed valve, which I have had in successful operation for some time.

Fig. 1 shows operation of boring the valve seat bushing.

Drill jig (A) is made of steel and hardened. The hole is ground to $\frac{7}{16}$" diameter. The shank of flat drill (B) is made a running fit in jig hole. Two of these drills should be used, one to drill a $\frac{3}{16}$" hole through bushing (C) followed by a $\frac{11}{32}$" drill to finish the hole.

Fig. 2 shows operation of facing down and squaring top of bushing (C). Reamer (D) is fed by jig (A) and is made just thick enough that when jig (A) bottoms on face of feed valve casting, bushing (C) will be the right height. Shank of reamer (D) is ground to fit neatly in jig hole and its end is square for a wrench.

Fig. 3 shows operation of making bevel seat on bushing (C). Cutters of reamer (E) are ground to 45° bevel. Shank is ground to same size as those of drill (B) and reamer (D). Collar (F) is made to fit reamer shank neatly, being left thick enough to accommodate a ¼" set screw. The reamer is dropped down on bushing (C). A disc about the thickness of two feed valve diaphragm discs is placed between collar (F) and top face of jig (A), set screw is then tightened, disc removed and reamer is turned until collar engages jig (A). This makes a true seat and will require but very little grinding to make a tight joint.

Fig. 4 shows a wrench (G) for turning regulating valve (H) while grinding; the spring giving the required pressure against valve. This is a much better method than slotting the ends of the valve.

Fig. 5 shows a mill or female reamer (I) for cutting down the shoulder that often arises on the face of the valve's seat, causing the valve to seat irregular, resulting in leakage at this point. The valve stem is caught in the drill press chuck (J) and reaming is done while holding the reamer in the hand.

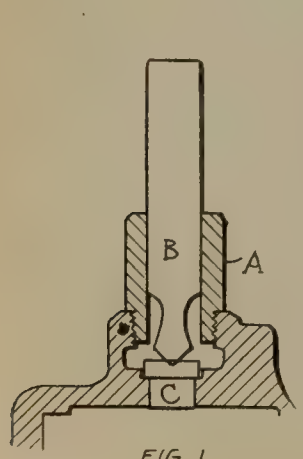


FIG. 1

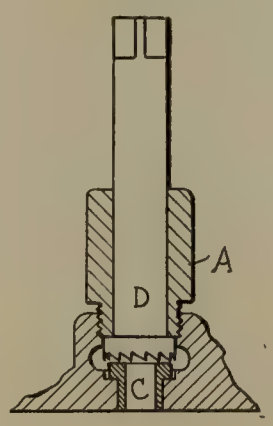


FIG. 2

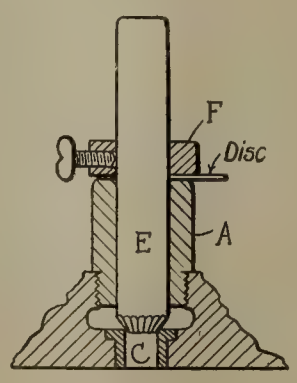


FIG. 3.

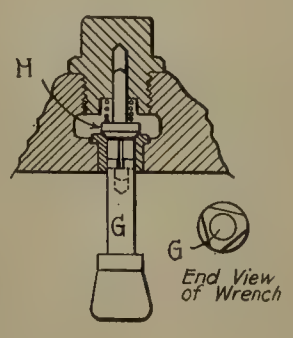


FIG. 4.

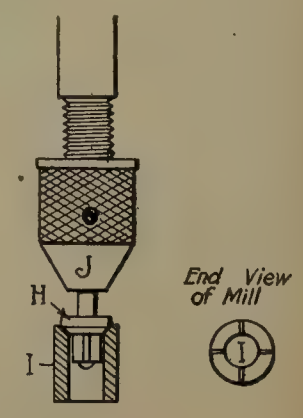


FIG. 5.

Feed Valve Repairs.

MALLETS FOR THE NORFOLK & WESTERN.

Extensive use of Mallet locomotives has been made by the Norfolk & Western in connection with its operating policy in the development of heavier train units. In May, 1910, this road put into service ten Mallet locomotives, five of which were of the 0-8-8-0 type, and five of the 2-8-8-2 type. These locomotives have demonstrated the possibilities of increasing efficiency and economy of operation by means of the great savings involved by increased train tonnage.

The development of the Mallet locomotive in the past two years has shown that with the addition of trucks increased boiler capacity may be obtained, thereby greatly increasing the sustained capacity of the locomotive, which is especially important in connection with road as distinguished from pusher service.

The Norfolk & Western officials, coöperating with the builders, after carefully considering this development in the light of the experience of this and other roads, produced the 2-6-6-2 type Mallets herewith illustrated. Forty of these Mallets were delivered by the American Locomotive Company during 1912, and forty more are now under order. It is interesting to note the extension of the use of Mallet locomotives in road service on this road, where conditions are especially favorable.

In ordering this equipment, it was the purpose of the Norfolk & Western officials, not so much to dispense with the pusher service, as to increase the maximum train load over the division.

On the Pocahontas division, between Eckman and Bluefield, five 0-8-8-0 type, five 2-8-8-2 type and fifteen of the new 2-6-6-2 type Mallets are being operated in both head end and pusher service.

On the Radford division, between Bluefield and Roanoke, five of the new 2-6-6-2 type Mallets are being operated in road service. This division is 105 miles long and includes a forty-mile grade of 0.4 per cent and a ten mile grade of 1.0 per cent. With the help of a pusher service on this ten-mile 1.0 per cent grade, these Mallets have increased the train tonnage from 2,800 to 4,000 tons.

The remaining twenty of the new 2-6-6-2 type Mallets are being operated in road service on the west end of the Norfolk division, between Roanoke and Crewe, a distance of 130 miles. On account of especially favorable terminal as well as road facilities, these Mallets are doing their best work on this division.

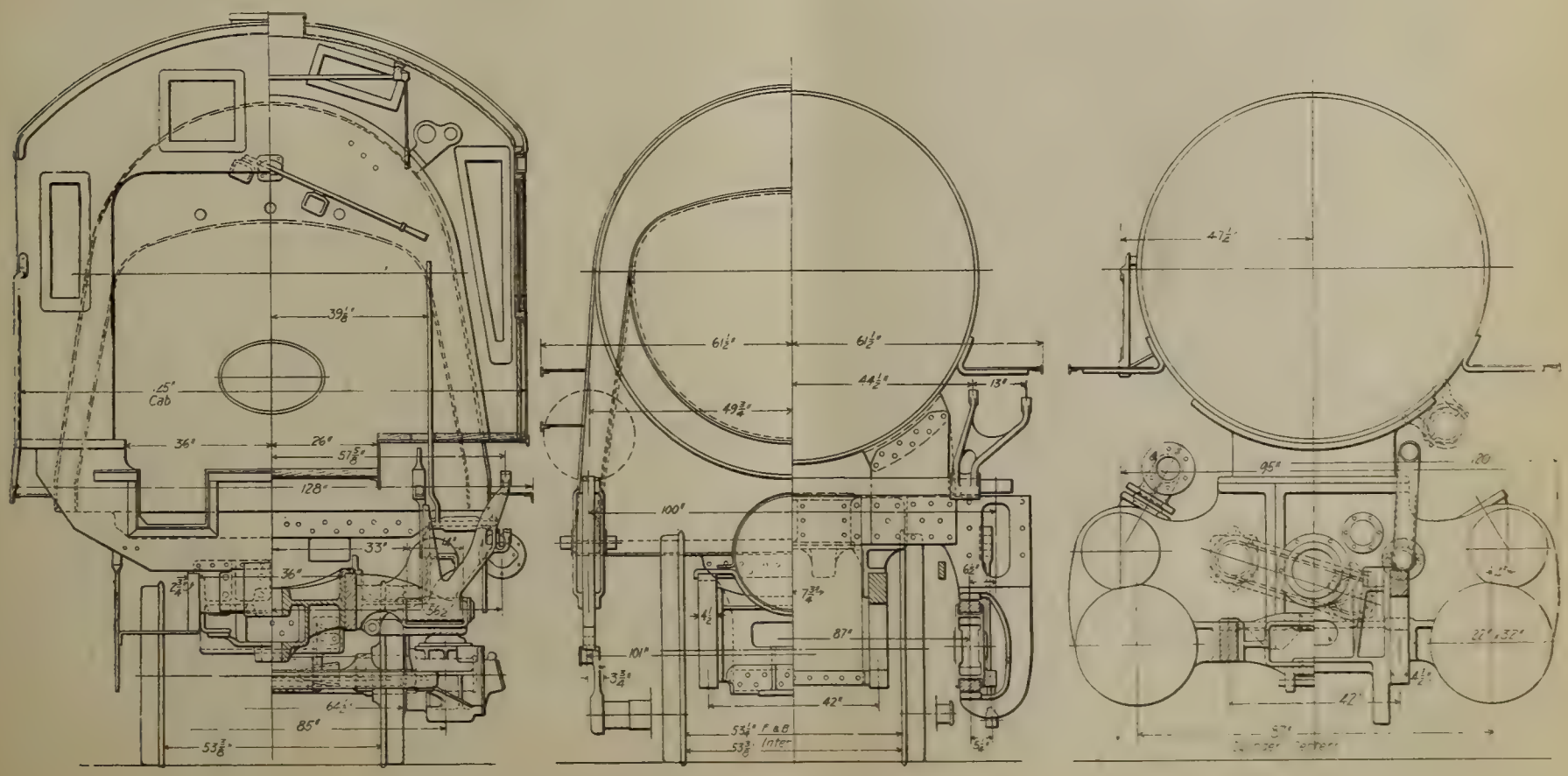
Before the installation of these Mallets the tonnage on this division was handled by 4-8-0 type locomotives, having a total weight of 260,000 pounds, 220,000 pounds being on drivers, and having a tractive effort of 52,500 pounds. Leaving Roanoke with a 3,500 ton train, which was the rating, two of these 4-8-0 type engines were at the head end. At Bonsack a 4-8-0 type engine was put behind the train to push it to Blue Ridge. At Blue Ridge the helper was cut out and returned light to Bonsack to await another eastbound train. From Blue Ridge the 3,500-ton train, with the two engines in the lead, proceeded to Phoebe. At Phoebe the lead engine was cut out and the train and the one engine continued to Crewe. The one 4-8-0 type engine readily hauled the 3,500-ton train over this portion of the road, except at Farmville it was assisted over the short grade by another 4-8-0 type engine.

At present, starting out from Roanoke with a 5,000-ton train, one of these Mallets is in the lead, double-headed by a 4-8-0 type locomotive. These two engines pull the train from Roanoke to Bonsack, a distance of 9 miles made up of broken grades. At Bonsack another of these Mallets is put behind the train and pushes it to Blue Ridge, a distance of 6 miles. From Bonsack to Blue Ridge there is a ruling grade of 1.2 per cent. At Blue Ridge the pusher cuts out and returns to Bonsack light. From Blue Ridge the two engines in the lead haul the train to Phoebe, a distance of 56 miles from Blue Ridge. This 56 miles is made up of broken grades but includes a 0.5 per cent grade 8 miles long. At Phoebe the lead 4-8-0 type engine is cut off and waits for a westbound empty train, helping as a double-header back to Roanoke. From Phoebe, therefore, the one Mallet, or through engine, hauls the train to Crewe, a distance of 59 miles of broken grade, with the exception of the 16 miles from Farmville to Burkeville. This 16 miles is made up of a continuous grade of 0.45 per cent and a 4-8-0 type engine is used here as a pusher.

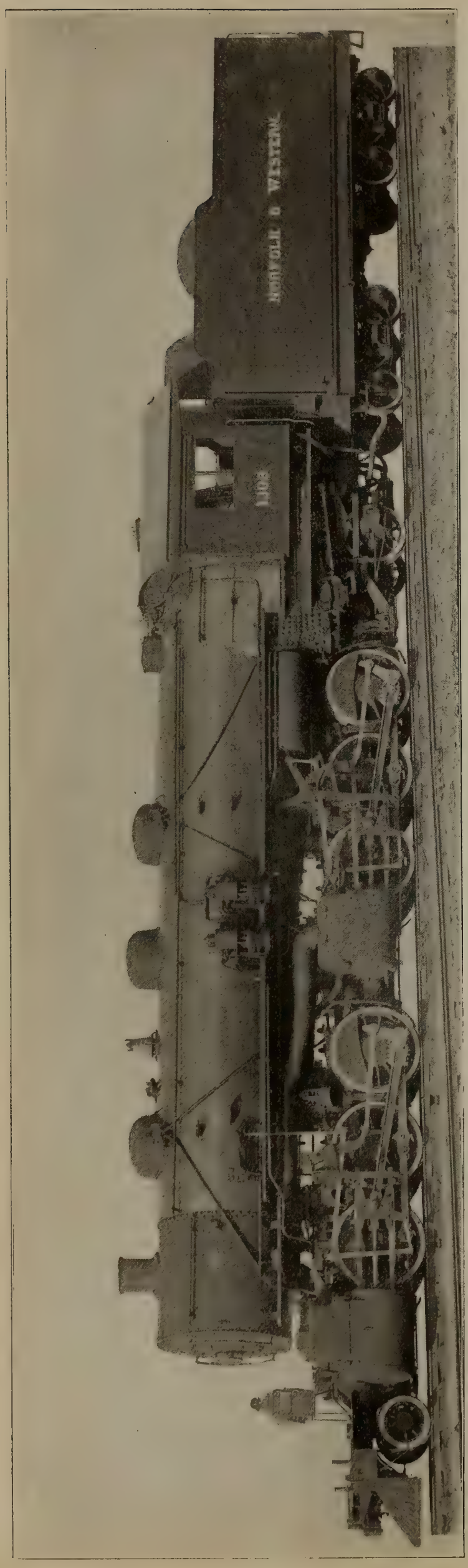
This means that on the Radford division train loads have been increased 79 per cent, and on the Roanoke division 43 per cent. Fifty-seven locomotives have been supplanted by these forty Mallets, and a reduction of 25 per cent has been effected in the number of freight trains operated over the divisions.

Details include the latest knowledge in locomotive engineering, improvements in design and the application of fuel saving devices.

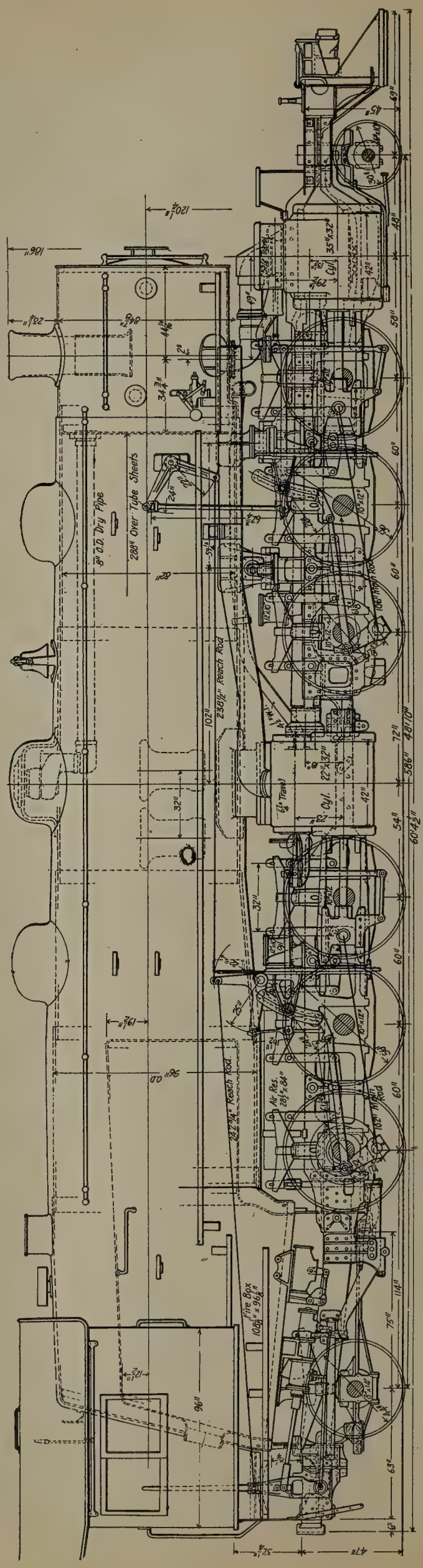
One of the principal features of interest lies in the boiler construction. The boiler incorporates a combustion chamber 78 inches long. This allows the firebox to be brought back of the rear driving wheels, thereby making it possible to obtain a good depth of throat sheet, without excessively increasing the length of tubes. As a result a throat sheets 18 $\frac{1}{16}$ inches deep is obtained with a tube length of 24 feet. High temperature superheat, fire brick arch, together with a combustion chamber 78 inches long, should give great economy in operation. Fifteen engines were equipped with Walschaert and twenty-five with Baker gear. All these engines



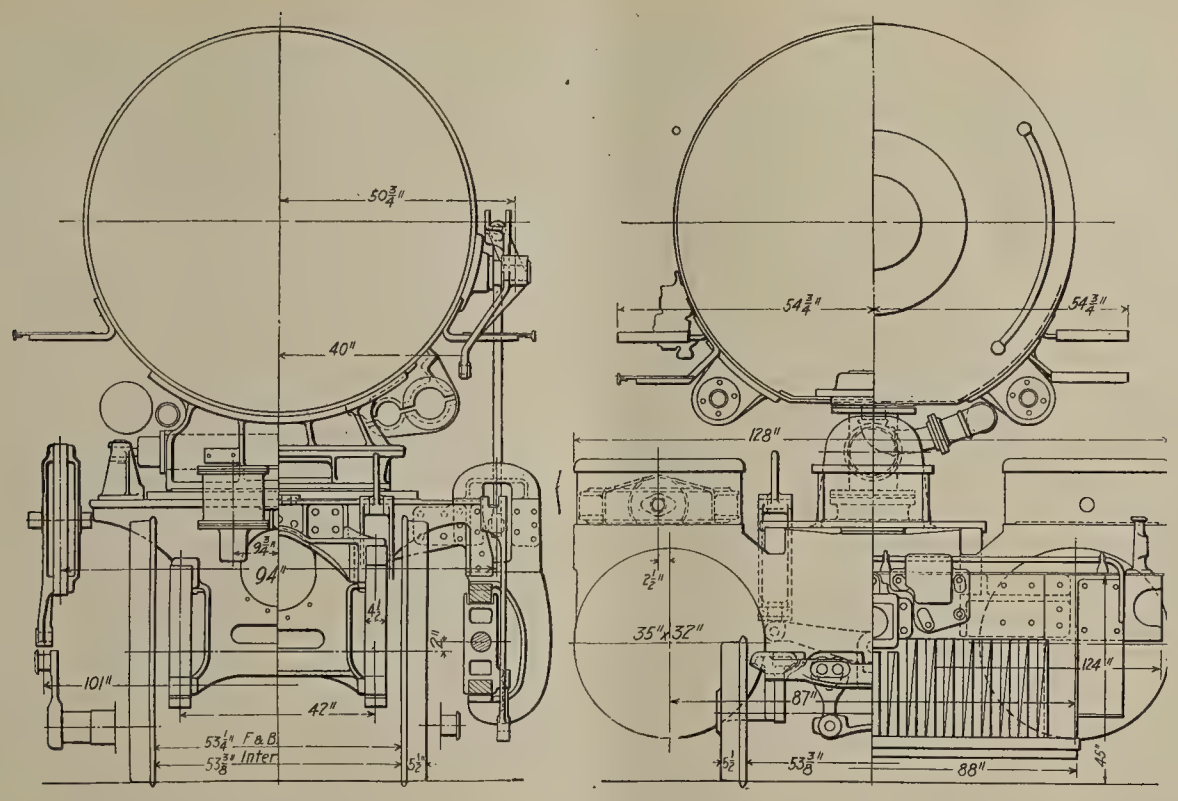
Sections of Mallet for Norfolk & Western.



Mallet for the Norfolk & Western.



Elevation of Mallet for the Norfolk & Western.



Sections of Mallets for Norfolk & Western.

have Street stokers. Reversing is effected by means of the builders' hydro-pneumatic reversing gear. This reversing gear not only renders the operation of the engine easier than that of the ordinary simple engine, but allows the use of steam with full throttle and cut-off arranged at the most economical point. The This truck was also used on the Chesapeake & Ohio Mallets and is similar in design to that successfully applied to a number of recent Pacific type locomotives. With the exception of the case above mentioned, the type of leading and trailing trucks applied to Mallet locomotives by the American Locomotive Company has been the radial swinging bolster type with journals inside of builders' latest style of outside bearing trailing truck was applied. wheels. The outside bearing truck used gives a wider supporting base and tends to add to the stability of the locomotive.

American Locomotive Company's system of compounding, including intercepting valve, was also applied. With this system of compounding, it is possible to increase the power of the engine about 20 per cent at critical moments, by admitting live steam to all cylinders. At the same time, the intercepting valve so controls the pressure of the live steam entering the receiver pipe that equal work is done in all four cylinders.

Outside of the features above mentioned, the design in general follows the builders' standard practice.

The following dimensions, weights and ratios of the new 2-6-6-2 type locomotive are of interest:

Type of locomotive, 2-6-6-2.

Service, freight.

Cylinders, 22 and 35x32 ins.

Tractive power, working compound, 72,800.

Boiler, type, conical connected; working pressure, 200 lbs. diameter, F. 83⅞ ins., B. 96 ins.

Firebox, length, 108⅛ ins.; width, 96⅛ ins.; grate area, 72.2 sq. ft.

Fuel, soft coal.

Tubes, number, 243 2¼ ins., 36 5½ inch.; length, 24 ft. 0 ins.; combustion chamber, 78 ins.

Heating surface, firebox, 343 sq. ft.; tubes, 4,655 sq. ft.; arch tubes, 25.4 sq. ft.; total, 5,023.4 sq. ft.; superheater, 995 sq. ft.

Driving wheels, diameter, 56 ins.; journals, 10x12 ins.

Truck wheels, diameter, front, 30 ins.; journals, 6x10 ins.; diameter, back, 44 ins.; journals, 8x14 ins.

Wheel base, driving, 10 ft. 0 ins.; rigid, 10 ft. 0 ins.; total engine, 48 ft. 10 ins.; total engine and tender, 79 ft. 3½ ins.

Weight on driving wheels, 337,300 lbs.; total engine, 405,000 lbs.; total engine and tender, 563,000 lbs.

Tender wheels, diameter, 33 ins.; journals, 5½x10 ins.

Capacity, water, gallons, 9,000.

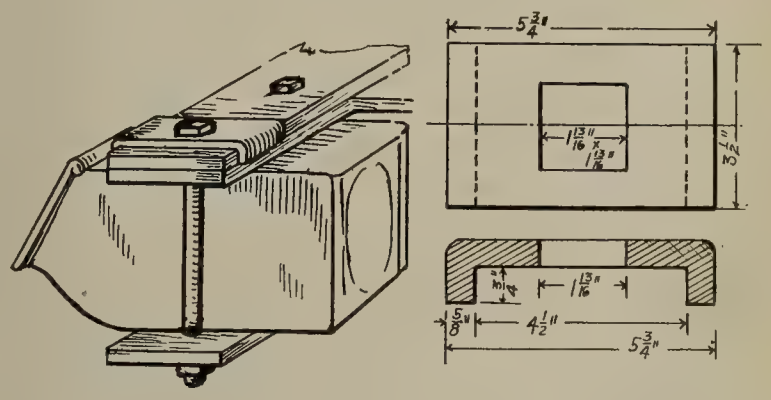
Capacity, coal, tons, 14.

JIG FOR THE CAR REPAIR TRACK.

By F. W. Bentley, Jr.

Journal box bolts are a hard proposition to hold while tightening the nuts against the tie bar, and more especially so after rust has accumulated in the threads of the bolt. It invariably requires the labor of two men to tighten them in this condition —one man holding the head with a strong S wrench. It is almost an impossibility for one man to do it.

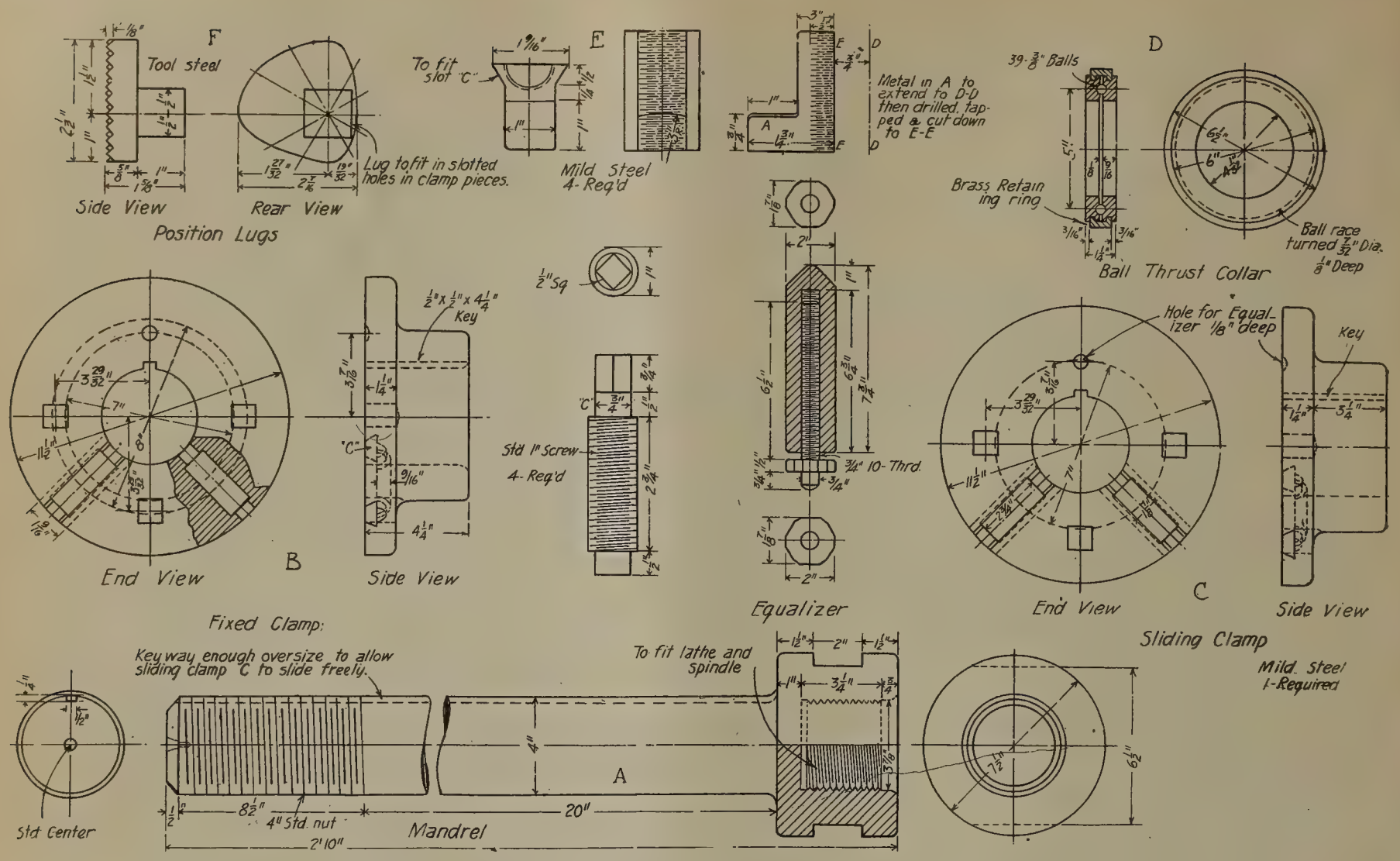
The above sketch is of a light device to drop over the head



Device to Hold Journal Box Bolts.

of the bolt and side of the arch bar. The bolt is consequently rigidly held from turning, no matter how hard a wrench may be applied to the nuts against the tie bar. The jig is lighter than an S wrench which would be required to hold the heads, and one man is all that is needed to use it.

In a large railroad shop, in the Middle States, a 72-inch three-drum sander is equipped with Carborundum Garnet paper in grits number ½, 1 and 1½, and with this paper it is possible to sand to a good finish complete freight car doors in one operation. The foreman of the car department says it is the best paper ever used on the sander and has been found successful for sanding all kinds of hardwoods. The grain stays on and is fast cutting.



Jig for Turning Box Brasses.

DRIVING BOX ARBOR.

By E. J. Brewster, Genl. Foreman C. & N. W. Ry.

Driving boxes and brasses are two of the jobs which require quick action in a large locomotive repair shop. The illustration shows a device I have designed to facilitate the turning of these brasses. To accomplish this and get results it was necessary to get away from the old practice of turning them on an arbor on centers driven by a dog and I designed the arbor shown in sketch.

"A" represents the main arbor which is threaded to fit the lathe spindle and screwed on same as face plate or chuck. This arbor has a ½-inch key or feather the entire length of arbor. "B" represents the fixed flange or clamp which is a tight driving fit on arbor. "C" represents the sliding flange or clamp which should be a free sliding fit on arbor. It will be noticed that in each of these flanges there are three 1-inch square holes. These are to receive jaws and lugs marked "F," which are of a cam or irregular shape. This is for the purpose of placing them in four different positions to hold brass, according to brass diameter, and allow tool to pass over brass in turning.

We leave a shoulder on wheel side of the brass to keep the brass from working out of box in case it becomes loose. Between the sliding flange "C" and 4-inch standard hexagonal nut there is a ball bearing washer marked "D." This is to give power in tightening up the brass on arbor. In flanges "B" and "C" there are two sliding jaws on each flange, marked "E." After setting a brass in proper position, these jaws will engage the brass on the inside and all that is necessary is to loosen nut, remove brass and put another in. There is no setting.

It is possible to complete a brass 12-inch diameter by 13 inches long, from floor to floor, in 15 minutes. I have taken a rough cut off this brass in two minutes from the time cut started, and a finishing cut in one minute. It is also a good feature to have three different thicknesses of washers to put between lathe spindle shoulder and arbor to distribute the wear on lathe gears.

ELECTRIFICATION ON NORFOLK & WESTERN RY.

The Norfolk & Western Ry, which extends from the tidewater at Norfolk, Va., to the coal fields of West Virginia, has contracted with the Westinghouse Electric & Manufacturing Company to supply all the electrical apparatus required to electrify the Bluefield-Vivan section of its line, some eighty-five miles in length.

The carrying out of this contract will give form to one of the most important projects of steam railroad electrification yet undertaken. The contract calls for the manufacture and delivery of twenty-six 130-ton electric locomotives of the single phase-two phase type, together with all required power house generating machinery and transmission apparatus.

Single phase alternating current of a frequency of twenty-five cycles and at 11,000 volts pressure will be supplied to the locomotives through an overhead suspended trolley wire and will be the identical type of the overhead system that has long been successfully used by the New York, New Haven and Hartford on its main line, by the Boston and Maine in the Hoosac tunnel, by the Grand Trunk in the Sarnia tunnel, and by the New York, Westchester and Boston, and for which installations the Westinghouse Electric and Manufacturing Company has furnished over 100 locomotives. The Norfolk and Western single phase-two phase locomotives, besides being of very large hauling capacity, will embody many unique features and requirements of design which, it is expected, will result in their showing unprecedented flexibility and economy of operation.

The Bluefield-Vivian section serves the celebrated Pocahontas coal region, one of the largest coal fields in the world. The tonnage of coal handled amounts to 65,000 tons a day, necessitating trains weighing as high as 3,250 tons. It is to facilitate the handling of this heavy traffic that the electrical operation has been decided upon.

There are a number of grades on this section, the maximum being two per cent, and at the present three Mallet locomotives (the most powerful type of steam locomotives built) are required per train. One locomotive is used at the head of the train and two for pushing.

Only two electric locomotives will be required for this service and the present speed will be doubled. The extent to which this quick train movement will enlarge the capacity of the railroad is quite apparent.

One of the present impediments to rapid operation of this section of the road is the extension of a 3,100-foot tunnel which is difficult to ventilate. This tunnel under electric operation will, of course, owing to the absence of smoke and noxious gases offer no impediment to frequent train movement.

Since the Norfolk & Western locomotives are intended for handling what is known among railway men as "tonnage trains" they will be built for running speeds of approximately seven, fourteen and twenty-six miles per hour.

The design of the electric equipment will be such that the tonnage can be readily increased in the future as the service demands. Power for the entire electrified section will be generated in a central power house located at Bluestone, W. Va., with an installed capacity of 27,000 kilowatts in turbo generators, supplied by the Westinghouse company.

The traffic conditions of this section of the road are especially well adapted to electrical operation. It is in reality a separate engine division at present, and can be operated electrically without affecting the cost of engine service on other sections of the line.

Conditions that are conducive to high economy in an electrification like that of the Norfolk & Western are:

1. Traffic requirements such that a minimum electrical equipment will give practically contiuous service.
2. Fewer engine crews per train.
3. The speed of operation over the division will be nearly double that possible with present steam equipment.
4. Increased capacity of electrified section.
5. Electric locomotives are not limited to the short hours of service on account of boiler and fire condition as in steam locomotives.
6. Watering and coaling delays incident to steam operation will be entirely eliminated.
7. The general reliability of locomotive operation will be considerably improved.

Work will be begun at once, and the contract calls for its completion in the summer of 1914.

Personals

THOMAS BOOTH succeeds J. R. Cook as general foreman of the Atchison, Topeka & Santa Fe (western lines) at Clovis, N. M.

J. J. WAGNER has been appointed foreman of the Atchison, Topeka & Santa Fe (western lines) at Waynoka, Okla.

J. B. MCCOY has been appointed division storekeeper of the Atchison, Topeka & Santa Fe at Las Vegas, N. M. He succeeds H. E. Bergmann.

K. CHYNOWETH succeeds George F. Daley as roundhouse foreman of the Central Vermont at Montpelier Junction, Vt.

W. H. MCAMIS has been appointed master mechanic of the Charlotte Harbor & Northern, succeeding S. B. Smith. His office is at Arcadia, Fla.

ERIC ERICKSON succeeds E. M. Wilcox as general foreman car department of the Lake Shore & Michigan Southern at Gibson, Lake County, Ind.

ALEXANDER YOUNG succeeds M. E. Rapp as general foreman, locomotive department, of the Chicago, Milwaukee & St. Paul at Chicago, Ill.

H. C. VAN BUSKIRK has been appointed mechanical superintendent, first district, of the Chicago, Rock Island & Pacific, with office at Des Moines, Ia. He succeeds J. B. Kilpatrick, resigned.

R. A. DOHERTY succeeds R. Hamlin as storekeeper of the Delaware, Lackawanna & Western at East Buffalo, Pa.

C. A. KOTHE has been appointed master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis at Galion, O., succeeding G. T. Depue.

G. T. DEPUE has been made shop superintendent of the Cleveland, Cincinnati, Chicago & St. Louis at Galion, O. He was formerly master mechanic at the same place.

J. A. READ has been appointed master mechanic of the Georgia Southern & Florida with office at Macon, Ga. For the past two years he has been general foreman at this point. Mr. Read served his apprenticeship with the Georgia Southern & Florida and has been employed by this road continuously for the past fourteen years with the exception of three years spent on other lines.

W. F. KADERLY has been promoted to general superintendent of the Georgia Southern & Florida with office at Macon, Ga. Mr. Kaderly is still superintendent of motive power of the Macon & Birmingham.

J. E. MCQUILLEN succeeds P. T. Dunlop as mechanical superintendent of the Gulf, Colorado & Santa Fe. His office is at Temple, Texas.

A. B. ADAMS succeeds J. E. McQuillen as master mechanic of the Gulf, Colorado & Santa Fe at Silsbee, Tex.

W. F. HOWARD succeeds A. B. Adams as general foreman of the Gulf, Colorado & Santa Fe at Cleburne, Tex.

W. D. BLAKNEY has been appointed acting foreman, tender shop, of the Intercolonial Railway of Canada, with office at Moncton, N. B. He succeeds Joseph Anderson.

THOMAS SPRATT has been appointed assistant purchasing agent of the Norfolk & Western with office at Roanoke, Va.

R. S. RAMSEY succeeds T. M. Vickers as general shop foreman of the Oregon Short Line at Pocatello, Ida.

H. MONTGOMERY succeeds F. C. Cleaver as superintendent of motive power of the Rutland. His office is at Rutland, Vt.

J. C. DUNHAM has been appointed general foreman of the Southern at Charleston, S. C.

J. D. WILLIAMS has been appointed general foreman of the Southern at Athens, Ga.

W. T. COUSLEY has been appointed master car builder of the San Antonio & Aransas Pass, with office at San Antonio, Tex. Mr. Cousley was formerly chief car inspector of the Elgin, Joliet & Eastern at Gary, Ind.

G. A. SCHMOLL, district superintendent of motive power of the Baltimore & Ohio, has been transferred from Wheeling, W. Va., to Pittsburgh, Pa., succeeding E. J. Searles, resigned.

J. F. BOWDEN has been appointed district superintendent of motive power of the Baltimore & Ohio at Wheeling, W. Va., succeeding G. A. Schmoll. Mr. Bowden was formerly master mechanic at Newark, O.

W. L. PROSS succeeds John C. Homer, Jr., as master mechanic of the Dayton, Lebanon & Cincinnati, with office at Centerville, O.

A. C. MANN has been appointed purchasing agent of the Illinois Central, with office at Chicago, succeeding J. C. Kuhns, resigned, to become vice-president of the Burden Sales Co. Mr. Mann's office is at Chicago.

F. K. MAYS has been appointed purchasing agent of the Atlanta, Birmingham & Atlantic, succeeding W. A. Hammel, resigned. His office is at Atlanta, Ga.

G. E. MCWHITE has been appointed assistant purchasing agent of the Atlanta, Birmingham & Atlantic, with office at Atlanta, Ga.

J. J. WATERS, superintendent of motive power of the Pere Marquette, has had his office moved from Grand Rapids, Mich., to Detroit.

W. S. BUTLER, master mechanic of the Chesapeake & Ohio, has been transferred from Huntington, W. Va., to Hinton, W. Va., succeeding F. J. Walsh, resigned, to accept service with another company.

C. B. HITCH, general foreman of the Chesapeake & Ohio at Covington, Ky., has been transferred to Hinton, W. Va.

A. G. ARMSTRONG succeeds M. P. Cheney as master mechanic of the Atchison, Topeka & Santa Fe at Needles, Cal.

J. W. FLICKWIR succeeds A. G. Armstrong as foreman of the Atchison, Topeka & Santa Fe at Los Angeles, Cal.

W. I. ROWLAND has been appointed motive power inspector of the Baltimore & Ohio. His office is at Baltimore, Md.

M. H. OAKES has been promoted to master mechanic of the Baltimore & Ohio at Grafton, W. Va.

D. H. WATSON succeeds M. H. Oakes as assistant master mechanic of the Baltimore & Ohio at Cumberland, Md. Mr. Watson was formerly general foreman at Garret, Ind.

F. K. MOSES succeeds D. H. Watson as general foreman of the Baltimore & Ohio at Garret, Ind.

J. J. FOLEY succeeds O. K. McCuen as general foreman of the Baltimore & Ohio at Weston, W. Va.

W. F. FORAN succeeds E. D. Morrison as general foreman of the Baltimore & Ohio at Columbus, O.

E. A. RAUSCHART succeeds E. K. Hinkens as general foreman, locomotive department, of the Baltimore & Ohio at Glenwood, Pittsburgh, Pa.

WILLIAM BATTENHOUSE succeeds F. H. Lee as general foreman, car department, of the Baltimore & Ohio at Glenwood, Pittsburgh, Pennsylvania.

W. W. CALDER succeeds T. M. Lillard as general foreman, car department, of the Baltimore & Ohio at Cumberland, Md.

A. B. SPENCER has been appointed general manager of the Crosbyton-Southplains with headquarters at Crosbyton, Tex.

W. J. HELMICK has been appointed superintendent of the Gulf, Texas & Western with office at Jermyn, Tex.

I. S. DOWNING, master car builder of the Lake Shore & Michigan Southern at Collinwood, has been appointed master car builder of the Cleveland, Cincinnati, Chicago & St. Louis at Indianapolis.

J. W. SENGER, master car builder of the Lake Shore, at Englewood, Ill., has been transferred to Collinwood shops, Cleveland, Ohio.

GEO. THOMPSON, assistant master car builder of the Lake Shore at Englewood, has been promoted to master car builder at the same point.

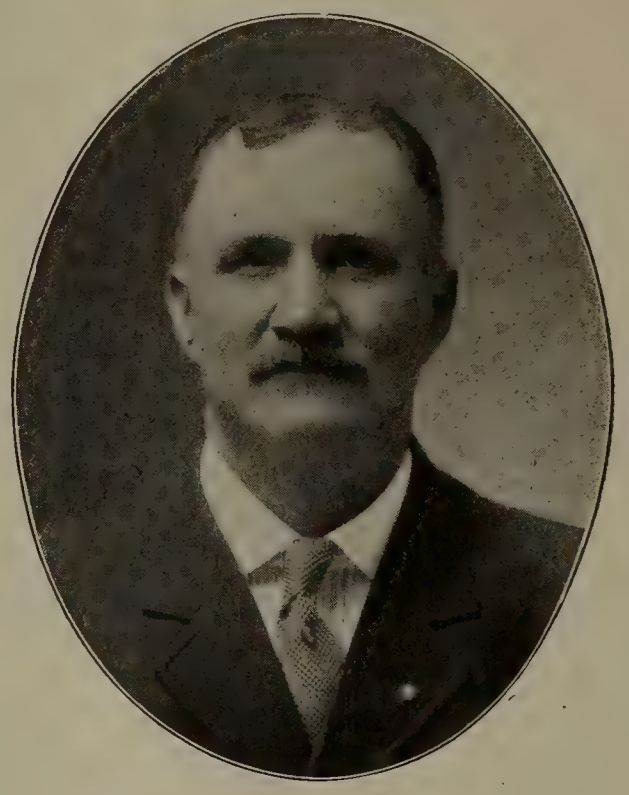
JAMES REED has been appointed assistant master car builder of the Lake Shore & Michigan Southern at Englewood, Chicago.

H. L. HANSON, son of F. H. Hanson, assistant master car builder of the Lake Shore, at Collinwood, O., has been appointed claim agent in charge of the St. Louis & Peoria division of the Big Four.

HOWARD M. BISCOE has been appointed vice-president of the Boston & Albany, with office at Boston, Mass. He succeeds I. H. Hustis, resigned.

F. PRICE has been appointed superintendent of car service of the Grand Trunk, with headquarters at Montreal, Que.

G. M. CROWNOVER has been appointed superintendent of motive power of the Chicago Great Western, with office at Oelwein Shops, Oelwein, Ia., succeeding T. G. Neuffer, resigned to retire from railroad service. Mr. Crownover was formerly shop master mechanic at Oelwein. Mr. Crownover was born at McVeytown, Pa., September 26, 1863. He graduated from the high school at Hampton, Ia., and entered the service of the Illinois Central at Waterloo April 1, 1881, as machinist apprentice, and served four years, after which he worked two years as journeyman machinist. April 1, 1887, he was transferred to Clinton, Ill., as roundhouse foreman, remaining in this position until April 1, 1892, at which time he was transferred back to Waterloo, Ia., to take a position as machine shop foreman. In October, 1896, he was promoted to General Foreman in charge of the Waterloo shops. December 1, 1900, he was transferred to Fort Dodge, Ia., as division foreman and remained there until April 1, 1902, then he took a position at Waterloo in charge of the new shops as general foreman. November 20, 1902, he was appointed master mechanic at Freeport, Ill., and on November 15, 1904, was appointed shop superintendent in charge of Burnside shops, Chicago, Ill. On December 20, 1909, he resigned to accept a position as master mechanic for the Chicago Great Western, at Oelwein, Ia., and was appointed superintendent of motive power of that road September 1, 1913.



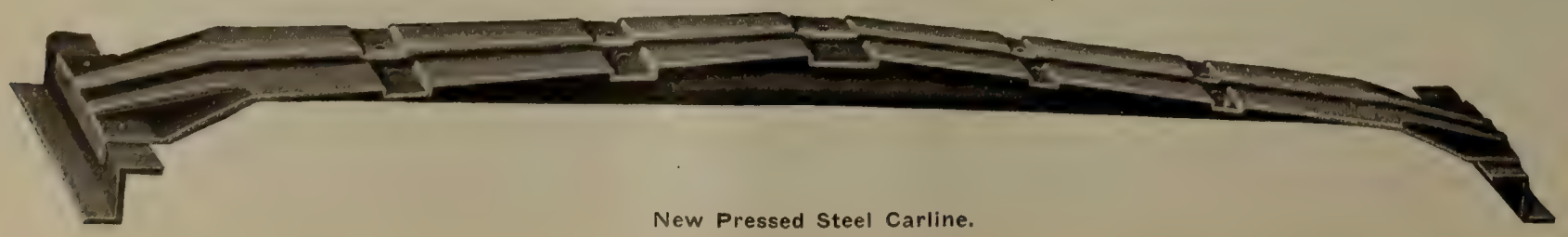
G. M. Crownover.

Among The Manufacturers

PRESSED STEEL CARLINES.

A new style of pressed steel carline has recently been designed by the Cleveland Car Specialty Co., of Cleveland, Ohio, in connection with the use of steel side plate in car framing. It is necessary that the carline should rest flat on the side plate with large bearing surface and the design here shown is now being placed on a large number of cars with steel side plates. While the design is intended for steel framing, it is equally applicable to the car with wood side plates. A recent test of this carline shows that it required a pressure of over 4,500 pounds to deflect it when placed upon supports representing the side plates. No other carline has ever stood so severe a test as this, and it shows that when properly secured to the side plates it is the ideal support for car roofs.

The use of pressed steel for carlines has made it possible to produce a design in which the maximum strength is gained



New Pressed Steel Carline.

with a minimum weight, as the whole carline can be made from one piece of steel and the metal placed where it is most needed. The various types of the Cleveland carline have proven this, as a carline of almost any desired strength can be so designed.

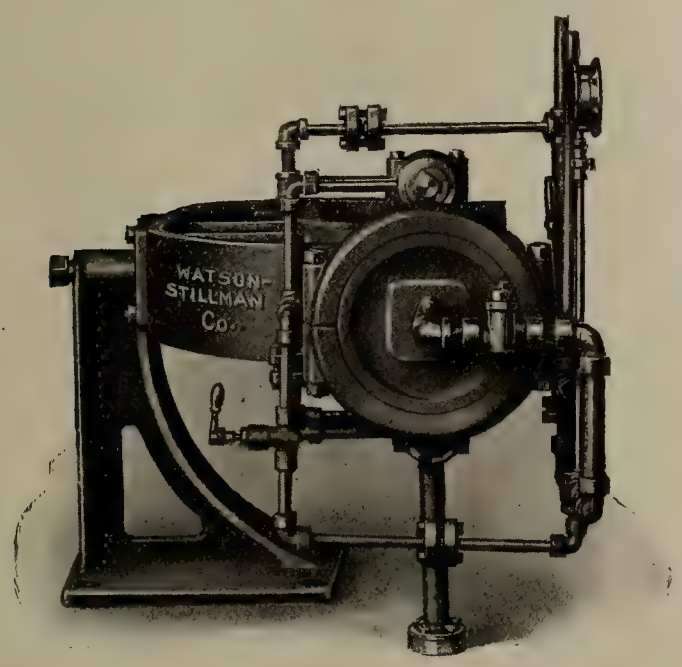
HYDRAULIC CAR COUPLER SHEAR AND RIVETER.

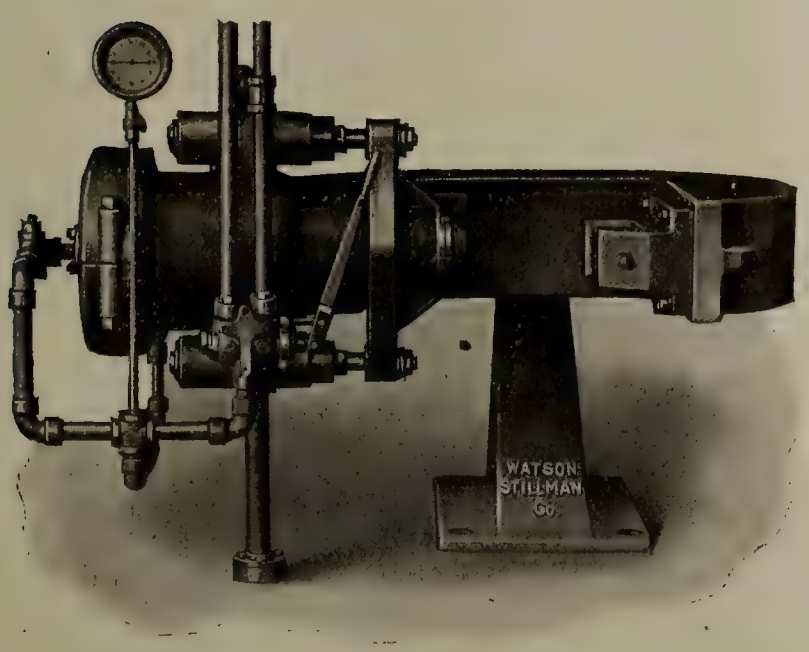
The Watson-Stillman Co., 50 Church street, New York, has just added another important type of hydraulic press to its line—an open jaw tool for shearing and riveting car couplers. It may also be used for miscellaneous shop jobs. Two views of the tool are shown here.

The cylinder is an integral part of the body of the machine, which is a steel casting made like an open jaw riveter frame. It is pivoted to the stand from the back face instead of being bolted to it from the bottom. This permits the casting to be swung from the position shown to the vertical or vice versa by merely loosening the clamping bolt and making a slight rearrangement of piping.

The end of the main ram works into a hole in a yoke with wings projecting beyond the sides of the main cylinder, where they join piston rods that work into small cylinders paralleling the main cylinder and bolted to it on diametrically opposite sides. The liquid, water or oil, is admitted to all the cylinders simultaneously, but because the displacement of the side cylinders is considerably less than that of the main cylinder the yoke travels faster, reaches the work ahead of the main ram and clamps the coupler yoke to the car coupler, forces the rivet into place, making everything ready for upsetting the rivet by the time the main ram catches up. If the yokes are being sheared from the couplers the action of the clamping yoke is unnecessary, as a stop valve is provided for cutting it out of service during this operation. The yoke and the main ram therefore travel out together. One stroke of the rams will upset one or shear two rivets. The clamping cylinders are made double acting in order that the return stroke can be effected by them.

When the machine is in the position shown there is no superstructure above the gap, thus permitting couplers to be carried to it by an overhead trolley, suspending them exactly in positions for either shearing or riveting. If in a vertical position the coupler may be swung into the dies in the same manner and with the same ease with which a billet is moved from a fire or furnace to an open jaw steam hammer.





Coupler Shearer and Riveter.

RALCO RECEPTACLE AND PLUG.

A design of receptacles and plugs to meet the demand for a reliable, heavy duty receptacle and plug for portable motors in shops, hotels, garages, office buildings and other places where portable machinery is used, has been placed on the market by the Central Electric Co., Chicago Ill. This device, called the "Ralco," is especially desirable for portable drills, riveters, grinders, vacuum cleaners, elevators and battery charging.

Ralco Plug and Receptacle.

The receptacle consists of two heavy porcelain blocks fitted with heavy phosphor bronze spring contacts. The receptacles are mounted in an outer heavy cast iron case on an angle to facilitate the insertion and withdrawal of the plug when installed upon a flat surface.

The No. 2 Ralco plug and receptacle are illustrated herewith. The No. 3 is the same design except it is for 60 amperes. The case for the No. 2 is fitted with D. & W. cutout No. 91102, while the No. 3 is fitted with D. & W. cutout No. 91108.

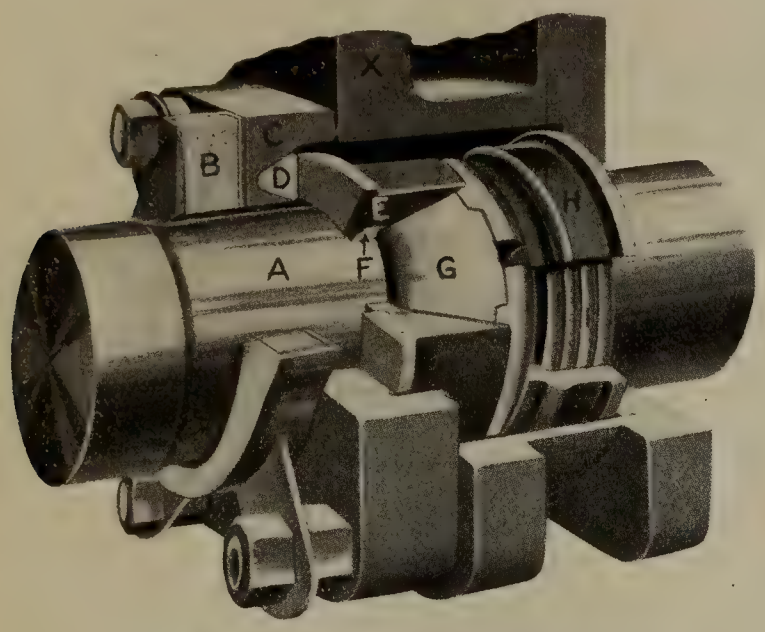
The plugs are non-reversible and are especially desirable for battery charging and other work where this feature is required and where the apparatus should be protected by fuses.

ROD PACKING FOR SUPERHEATER LOCOMOTIVES.

The fast increasing use of superheater locomotives has brought about many necessary readjustments in locomotive accessories, the most marked of which perhaps is that of metallic packing. Metallic packing which answered the saturated or even dry steam conditions pertaining before the advent of superheated steam proved of no value under the changed conditions, owing to the increased heat combined with the friction of the packing on the rods, as also the fact that oil is not carried as readily by

the highly vaporized steam under superheated conditions, and therefore a lesser quantity found its way to the rod and packing.

The Jerome-Edwards Metallic Packing Co., of Chicago (formerly the Jerome Packing Co.), claims to have solved this vexing problem after three years of close study and experimentation. It was necessary, however, to go outside of their own design owing to the peculiar conditions to be met, and to find



New Type Superheater Metallic Rod Packing.

a packing that would be steam tight under all conditions, yet so constructed as to minimize the pressure on the rods. This combination was admirably worked out in the Edwards packing, as illustrated herewith—the only lubrication necessary is that afforded by swab (B), which is a very material point. In gland (C) is a babbitt seat (D) for vibrating cup (E), which is always tight without grinding—the two-piece brass ring (F) only requires renewal when rod has been turned down ½ inch or more. Two packing rings (G), so arranged in combination with each other and the follower that they automatically take up and remain tight till worn out, and make it impossible for openings in rings to come in line and allow leaks. Combined follower and spring case (H), the concaved end of which, meeting the convex end of packing ring (G), prevents full force of steam from forcing main packing ring into vibrating cup, thus minimizing the tension of main packing ring, yet affording the necessary graduated pressure to make it steam tight under all conditions.

The Jerome Packing Co. has consolidated with the owners of the Edwards Packing under the firm name of the Jerome-Edwards Metallic Packing Co.

THE SOUTHERN STEEL CO.

For the past four months an association of New York, Milwaukee and Chicago parties has been at work assembling the necessary material and conditions for the establishment of an extensive iron and steel industry in the South. The parties have acquired a large tract of land in Cuba containing deposits of high grade iron ore. This tract of land embraces an area of five hundred thousand acres. It is heavily wooded with mahogany, lignum-vitae and other hard woods common to the island. The land is advantageously situated with sea frontage, with a land-locked harbor.

Having secured this ore deposit the parties found a suitable location upon the coast convenient to coal, fluxing, transportation and the like. With reference to the low cost of assembling the raw materials and distributing finished products they have secured as a location for the plant a tract of land located upon the Mobile River north of the city of Mobile. This land has a river frontage of about two miles. There have been likewise secured deposits of coal and limestone within easy reach of the mill accessible to barge transportation.

The Louisville & Nashville crosses the land north and south upon the east side; upon the west runs the Southern Railway. The mills are to be located between the L. & N. track and the river and between the L. & N. and the Southern the town-site is located.

Contracts have been let for cutting and clearing away the timber and undergrowth preparatory to putting the mill site in condition for the erection of buildings and the installation of machinery. The town to be called "New Mobile" is being platted. The work will be pushed all along the line and it is expected that the mills will be in operation within the next eighteen months.

The mills will cost approximately $5,000,000.00 and will have an initial capacity of one thousand tons per day and will be increased as conditions may require. The name of the company now organizing for the purpose of taking over and operating this enterprise is The Southern Steel Company.

In addition to the general steel and iron products the company will have the right to manufacture in the United States steel rails and structural steel with "Interlocking Joints," the patents for which are owned by the Inter-Locking Rail & Structural Steel Company. The Southern Steel Company will also own the exclusive rights to "Interlocking Joints" for both Canada and Mexico.

New Literature

The American Locomotive Co., New York, has issued Bulletin 1014 entitled: "The most powerful locomotive in the world." This was a Mallet locomotive of 115,000 pounds tractive power (working compound) built for the Virginian Ry.

* * *

Tate, Jones & Co., Inc., of Pittsburgh, have issued a twenty page circular (No. 142) on fuel oil data. It contains considerable information on the subject of fuel oil, records of tests and a number of illustrations of oil furnace installations.

* * *

"The handiest tool in the shop" is the designation of the portable floor crane and hoist manufactured by the Canton Foundry & Machine Co., Canton, O., and fully described in a recent booklet. This crane is especially adapted for handling heavy castings and effects a great saving in transporting them about the shop. This firm has made a number of large sales to railroad shops during the past few months.

* * *

The Westinghouse Electric & Mfg. Co., of Pittsburgh, Pa., has just issued leaflets Nos. 3572 and 3660 covering the electrification of the New York extension of the Pennsylvania Railroad, and the New York, New Haven & Hartford Railroad, respectively. These leaflets cover the salient points of both roads together with a description of the more important parts of the equipment. These leaflets are well illustrated and contain maps showing the territory covered by both the electrified systems.

* * *

The Chicago Pneumatic Tool Co., Chicago, Ill., has issued Bulletin No. 34 R, covering "Chicago Pneumatic" class L-SS and L-SB compressors of the enclosed self oiling types.

* * *

The Mark cold drawn steel union is fully described and illustrated in a recent pamphlet of the Mark Mfg. Co., of Chicago. All the parts of this union are drawn and pressed from cold flat steel. The female portion has a brass seat ring and the advantages of the brass union are combined with those of the steel union.

* * *

The Whole "Kewanee Family" is the title of a booklet recently issued by the National Tube Co, Pittsburgh, Pa. It is in the attractive form which characterizes the literature of the company and is a complete catalogue of the various types

of Kewanee unions, check valves and cocks. The distinctive feature of these unions is the brass to iron connection.

* * *

The Markel devices, which are now being handled by the Equipment Improvement Co., New York, are illustrated and described in a recent catalogue of that company. These devices include a removable driving box brass, flangless shoe and wedge and the solid head main rod.

* * *

A number of bulletins issued from time to time by the Hisey-Wolf Machine have been brought together under an attractive binder. These bulletins cover various types of portable electric drills.

* * *

The new catalog No. 20 recently issued by the L. S. Starrett Co., Athol, Mass., is a most complete catalog of mechanics' fine tools. It contains some 320 pages of interesting descriptions, illustrations and prices for all kinds of tools for machinists, carpenters, draftsmen, engineers, chauffeurs and other mechanics. In adition there will be many pages of data and tables such as metric conversion tables, decimal equivalents, weight computing tables, tapers and angles, wire gage tables, etc.

Industrial Notes

Harry W. Finnell, who for some time has been eastern representative of the Carbon Steel Co., as manager of railway sales, has been appointed assistant to the president of that company, in general charge of sales. He will make his headquarters in Pittsburgh, Pa.

H. S. Thompson, manager of the railway department of the Edison Storage Battery Co., Orange, N. J., has been made a vice-president of that company.

Manning, Maxwell & Moore, Inc., New York, together with their subsidiary companies, will move their general offices about October 1 from 85-89 Liberty street to the new Lewisohn building, 113-119 West Fortieth street.

The National Tube Co., Pittsburgh, Pa., has entered the electrical conduit field and has contracted with the National Metal Molding Co. and the Safety-Armorite Conduit Co. to manufacture and sell this product for it as agents.

The B. F. Sturtevant Co., of Canada, Ltd., has recently been incorporated in Canada and will build a plant at Galt, Ontario. From this plant the company will handle all business in Canada and also export to England, Australia and other foreign countries. Arrangements have been made to provide for an expansion of this plant up to ten acres.

The Taylor-Wharton Iron & Steel Co., High Bridge, N. J., has opened a branch office in the Candler building, Atlanta, Ga., in charge of H. F. McDermott as engineer and district sales manager; this office will also be a branch office of Wm. Wharton, Jr., & Co., Inc., Philadelphia, Pa., the Tioga Steel & Iron Co., Philadelphia, and the Philadelphia Roll & Machine Co., Philadelphia.

J. C. Tipton has been made Canadian representative of the Galena Signal Oil Co., New York, with office in Montreal, Que., succeeding A. Lichtenhein, deceased. The Montreal office of this company is now located in the Shaughnessy building.

The American Car & Foundry Export Company has filed articles of incorporation at Dover, Del. The capital stock is $500,000 and the incorporators were John M. E. Ames, New York city; William M. Hagar, Roselle, N. J., and Charles S. Gathrop, Wilmington, Del.

Charles M. Schwab has been elected a director of the American Locomotive Co., to succeed C. A. Coffin.

The receivers for the Barney & Smith Car Co. have issued a statement which conveys assurance that the assets of the corporation greatly exceed the liabilities. The total assets are $5,574,244 and total liabilities $4,048,960, showing an excess of $1,525,284. The receivers say the company has on its books a large number of unfilled orders.

C. R. Weaver has been made vice-president of the L. J. Bordo Company, Philadelphia, Pa., succeeding C. W. Allen, resigned. Mr. Allen has also resigned his position as a director of this company.

William G. Bee, formerly manager of sales of the Edison Storage Battery Company, Orange, N. J., has been made a vice-president and general sales manager of that company.

The Indiana Car & Equipment Company has recently opened a new plant at East Chicago, Ind., for building and repairing freight cars. P. H. Joyce, who is also president of the Illinois Car & Manufacturing Company, is president and treasurer of the new company, and L. J. Smith is secretary. The general offices are in the Great Northern building, Chicago.

Geo. M. Basford, chief engineer of the Joseph T. Ryerson & Son, has accepted appointment as a member of the general executive committee of the Railway Business Association. Mr. Basford in the early months of the association, and while assistant to the president of the American Locomotive Co., served for a time as acting secretary of the organization, and has since kept in close touch with its work.

J. C. Kuhns has resigned as purchasing agent of the Illinois Central to become vice-president of the Burden Sales Co., with office at Chicago.

M. F. Ryan, who has been connected with the Pittsburgh Spring & Steel Co. for the past 10 years has been appointed general western sales agent of that company, with offices at 1411-13 Fisher building, Chicago, Ill., in place of L. C. Noble, deceased.

J. H. Sharp.

J. H. Sharp, formerly storekeeper at the Armour Car Lines' shops, Chicago, has resigned that position to engage in the railway supply business. Mr. Sharp has been connected with the Armour company for more than five years, having started with them as a special apprentice immediately after leaving school, and has had a very rapid rise in the car building business. The new company is known as J. H. Sharp, Railway Supplies, and has its offices in Suite 700 of the Railway Exchange Building, Chicago. The company is handling, with other lines, the Monogram ladder and the "D P" dust guard, both articles of merit and widely used on several of the leading railways. A host of friends welcomes Mr. Sharp into his new field and predicts a large measure of success for him.

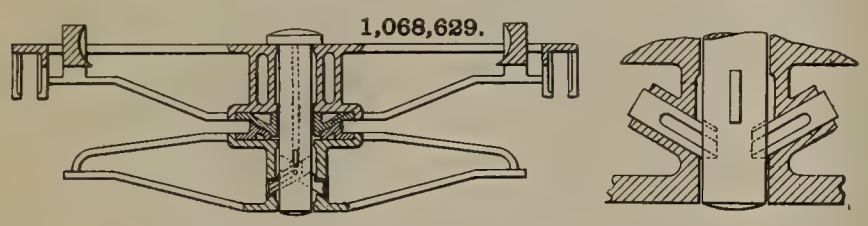
Recent Railway Mechanical Patents

CAR CONSTRUCTION.

1,068,629—James M. Coleman, Montreal, Que.

This invention relates to improvements in means for connecting car trucks to car bodies without impairing the flexibility of the car body in its relation to the trucks. The object is to provide a connection so designed and arranged that the trucks of a car will not leave the car body in case of an accident, thereby preventing the telescope of the cars.

The king pin is provided near its lower end with a pair of oppositely sloping slots arranged in parallel vertical planes. Slidably mounted in each of these slots is a latch of such length that it may be contained entirely in the pin slot. The lower end of each latch is cut away from the upper edge to form a horizontal surface adapted to engage the top of the slots, as clearly shown in the figure. In order to prevent the latchesescaping entirely from the slots, the latches are each provided along one side with a groove extending from the lower end of the latch almost to the upper end thereof. This groove is adapted to be engaged by a pin or lug



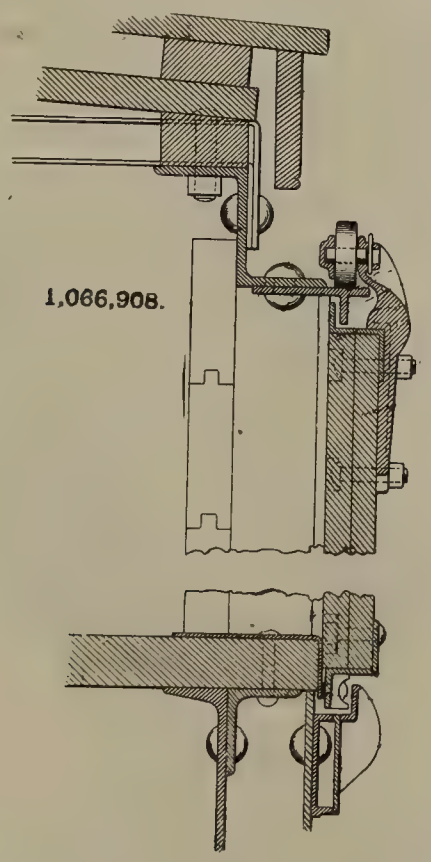
mounted on the king pin and projecting into the latch slots. In this way, when it is desired to remove the latches, they may be forced upwardly in the slots and withdrawn from the upper end, but they cannot escape accidentally as the force of gravity operates to hold them in the lower ends of the slots from which they cannot escape, owing to the lugs abutting the upper ends of the grooves.

The operation of the device is so obvious that only an outline need be given. When the pin is dropped into place, the walls of the aperture hold the latches up in their grooves, but when these latches come opposite the slots they slide out by gravity, so that the king pin cannot be removed without pressing the latches up into the notches. As these latches are operated by gravity, vibration only operates to keep them in their proper position.

CAR STRUCTURE.

1,066,908—Belden D. Jones, Chicago, Ill., Assignor to the Jones Car Door Company, Chicago, Ill.

The salient object of this invention is to provide an improved and novel form of supporting and confining the sliding car door, the con-



struction being particularly adapted for use with that type of freight car having a steel or sheet-metal outer facing.

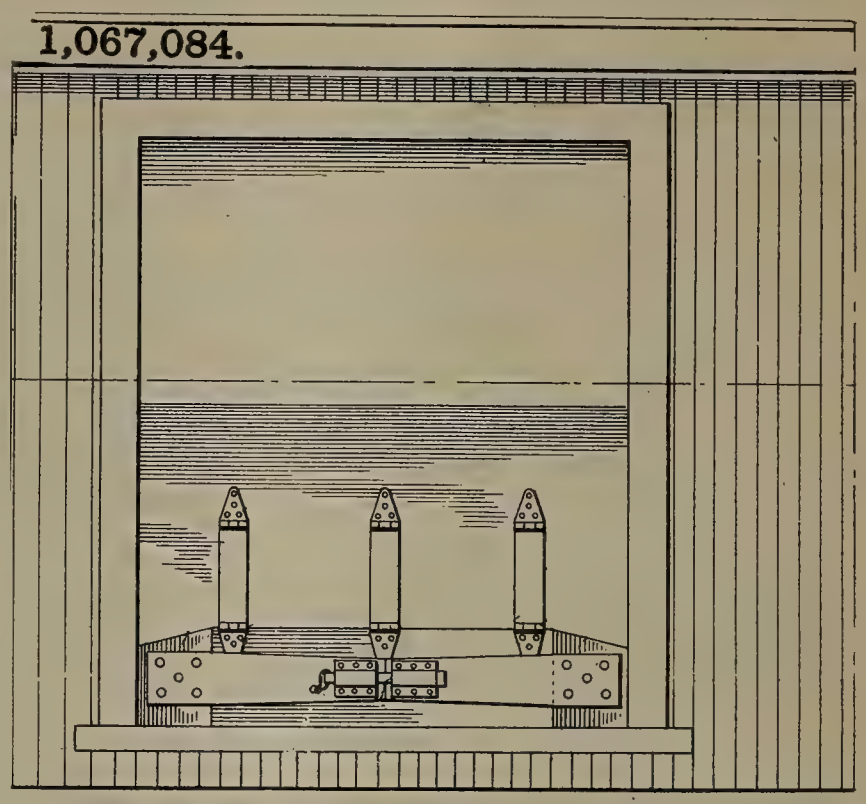
Other objects of the invention are to provide a construction of the character referred to which insures of the track wheels being at all times properly confined on the trackway and at the same time permits a free and unconfined movement of the door as it is moved into open or closed position; to provide a construction which insures of a weather-proof joint at the upper end of the car door opening; to provide a construction of the character referred to of an improved form of combined weather guard and door stop; to provide a construction which is particularly characterized by its simplicity and economy of manufacture; and in general to provide an improved construction of the character referred to.

As an important feature of the invention, a novel form of track member is provided which also serves the function of confining the door structure in place, and in addition forms a weather proof fit at the upper end of the car door opening.

GRAIN-CAR DOOR.

1,067,084—Frank F. Wandtke, Superior, Wis.

The purpose of this invention is to provide a door which has its lower extremity hingedly connected thereto, an auxiliary door, means being provided whereby the auxiliary door is tightly locked against the door frame, and the said auxiliary door adapted to be opened and swung upwardly to permit of a certain amount of



grain, vegetables, or the like, being removed from the car before operating the main door.

The aim is also to provide a car door, having means whereby the same may be readily raised and swung within the car, suitable suspending means being provided for sustaining the door as well as the auxiliary door in such a position against the roof of the car when the car is not being used.

In operating the auxiliary door, the end sections are first swung inwardly a slight distance, it of course being understood that the seal is detached from the bolt and that the bolt has been partially withdrawn from the way of one of the arms. The end sections of the auxiliary door may then be forced inwardly a sufficient distance to allow the said end sections to escape the side members of the frame for the door, when the locking bars of the auxiliary members may be grasped and the door swung outwardly and upwardly upon its hinges. The door is sustained in an elevated position until sufficient grain or the like is withdrawn by the opening thus formed, to permit of the grain door being raised and sustained within the car.

The Atchison, Topeka & Santa Fe is reported to be planning improvements at Los Angeles, Cal. It is also said this road has purchased a large water front tract and will build machine and car repair shops, a power and pumping plant and a large round house near Redondo Junction, near Los Angeles, Cal.

The Chicago & Eastern Illinois is said to be planning improvements at Salem, Ill., which will involve an expenditure of about $80,000.

The Chicago, Burlington & Quincy, it is stated, will soon dismantle its shop at Denver, Colo., and work will be started at once on new shops and roundhouses at Derby, seven miles north of Denver station. The improvements, it is reported, will cost about $150,000.

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Automatic Connectors

Within the past decade a number of devices for automatically connecting the steam, air and air signal hoses between passenger cars, have been tested out. In most cases faults of minor nature have been found and in two or three instances seem to have been since eliminated.

Still there is hesitancy upon the part of mechanical and operating department officials in taking the initial step in equipping passenger trains for completely automatic coupling. There can be little doubt but that the correct principal has been found and that the devices embodying it are perfectly practical.

Is not, then, this hesitancy due to fear that the partial equipment of cars may bring upon the railways legislation compelling its universal application within a short period? If so, we have reached a point where state legislation is actually retarding the development of meritorious safety and efficiency devices.

We have not, however, so lost our respect for the fair mindedness of those responsible for state legislation bearing upon the operation of railways, as to believe that there is occasion to allow its fear to affect such cases as the one mentioned.

The automatic connector is a perfectly logical improvement in car equipment. If the inventions now on the market are worthy of exhaustive trials they should be recognized as such. Their first cost is very small and the saving in hose maintenance alone seems to be sufficiently great to warrant their installation. The fact that they inter-couple with M. C. B. standard equipment is a great feature in their favor as during the transient stage their usefulness is not handicapped.

Freight Car Troubles

The above is the subject of a paper recently delivered before the Central Railway Club by J. C. Fritts, master car builder of the Delaware, Lackawanna & Western, extracts from which are published on another page. The subject is a familiar one to railway officials but Mr. Fritts has given the subject particular study and presents some interesting observations.

It will be remembered that at the June meeting of the Master Car Builders' Association, a motion was made and carried that a committee be appointed to look over the car situation with a view of recommending to the American Railway Association the retirement of the older cars. This was subsequent to the discussion on the retirement of 40,000 and 50,000 pounds capacity cars. Mr. Fritts states, however, that the question is one of draft timbers, draft gear and buffing arrangement, more than capacity or even age and in this he undoubtedly has the backing of the majority of railway men. He suggests the substitution for the short draft arm, one of metal construction extending back of the bolster and that cars which would not warrant repairs of this nature should be confined to local service. One road at least is transferring cars of 40,000 pounds capacity, rather than handle them over its line. To keep weak cars on the lines of the road owning them would seem the logical thing to do but to make the distinction on the basis of capacity does not seem proper as there are many light capacity cars which could be made capable of withstanding present-day conditions. The retirement of cars of a cer-

tain capacity at this time would involve a heavy expense on all the roads, at a time when they are already sorely pressed and this is a feature which should receive very careful attention. A systematic study of conditions and remedies therefor on light capacity cars is needed and will undoubtedly be made by the Master Car Builders' committee which is now going into the subject.

After taking up the various means of strengthening the underframe, Mr. Fritts takes up the matter of draft appliances and the performance figures which he gives are remarkable. Furthermore, they correspond to the experience of a large majority of roads. On one large system the number of couplers pulled out and broken during the past year has more than doubled and the same holds true with regard to draft timbers. At the same time car mileage has not increased. During the past year or two there has been a great deal of heavy power introduced and but little attention paid to the ability of cars to withstand the added strains. Methods of strengthening cars at present in use an needed and if any of our readers have any suggestions to make along this line or have criticism on Mr. Fritts' paper we should be glad to hear from them.

Trespassing

Marcus A. Dow, general safety agent of the New York Central Lines, is the author of an article in the *Outlook* of September 27, entitled "A Nation's Neglect," which deals with railway trespassers and the number of lives lost as a result of this evil yearly. Quoting from an address of C. C. McChord, Interstate Commerce Commissioner, he states that during the past twenty years, 86,733 trespassers have been killed and 94,646 trespassers injured on railways of the United States. A large railway system recently made investigation of this question and found that over 75 per cent of the trespassers killed were wage earners and citizens living near where they were killed, and that only a small percentage were "hoboes." Mr. Dow's article contains numerous illustrations showing factory workers, children and others taking a short cut across the railway tracks.

There are two things which Mr. Dow urges to stamp out this evil—education and legislation. Most states have no adequate law against railway trespassing and the public does not realize that the large percentage of those who meet their death while trespassing are wage earners. He urges that education along the lines of safety should begin in the schools, stating that between 1901 and 1910, 13,000 children under 14 years of age were killed or injured while trespassing on railways and 20,000 between 14 and 21 years of age were killed or injured. The laws on the subject of trespassing are not uniform and even if a trespasser is arrested, the disposition is to look at the railway as assuming a domineering attitude and to let the offender off easy.

Mr. Dow's article is very much to the point and is timely. Something must be done to arouse the American public to the great loss of life which occurs through trespassing. In England, as is well known, trespassing on the railway right-of-way is not tolerated and an offender is harshly dealt with. It is true that conditions are somewhat different there and that the location of many tracks near factories and elsewhere in this country makes it very easy to trespass. There are probably some cases where the roads could lessen the temptation for trespass by fencing at certain points. Nevertheless the trespassing evil should be greatly decreased and the public should be taught its disastrous consequences. The New York Central Lines are posting notices all along the line and are seeking the co-operation of the police courts, judges, manufacturers and others in abating the evil and other roads will undoubtedly follow along similar lines.

Co-operation

If there is one thing which makes for the success of any organization it is co-operation between the various departments and the ability of all to work for the common end. This is especially true of our railways, with their many complexities of organization. A shop may have all the latest and most improved facilities for handling work, but unless there is co-operation between the men and the foreman, between the foremen and the superintendent, it will be easily outdistanced in efficiency by shops lacking many of its advantages. Although it is preferable that a shop be as up-to-date in its equipment as possible, it is not always necessary to its efficiency. The shops of the North Western at Chicago, for example, were built many years ago (the greater portion of them) and yet they are among the most progressive and up to date in the country. It is due to the spirit of co-operation which exists there. Again, there must be the spirit of co-operation between the shop and the office. It is sometimes the case that there is more or less bucking between the drafting room and the shop. In an article on the "Value of the Drawing Room," published elsewhere, Mr. Freeman calls attention to the fact that shopmen often fail to follow the dimensions and specifications given on blue prints, giving as an example the case where some change in design is made without the knowledge of the drawing room, and where afterward a new part is ordered, according to the blue print, it is found that it will not fit. It is lack of co-operation of this sort that cuts down the efficiency of an organization. It is particularly necessary that the drawing room and the shop work together understandingly, for it is the drawing room that makes the records for all that passes through the shop. In this connection it might be said that a better understanding might be arrived at if the draftsman would give more attention to following his drawings through the shop and if the shop man would visit the drafting room occasionally and give the draftsman a few notes from his end of the work.

Regular meetings of shop foremen, draftsmen, test department men and master mechanics, where each can give to the other his viewpoint, cannot help but result in greater co-operation and should be fixed affairs in all railway mechanical organizations. Finally, when you come to an organization where you find that this spirit of co-operation, of progressiveness exists, you can follow it up through the various branches and sub-departments and at or near the head you will find one man who is its source.

THE CAR REPAIR barns of the Armour Car Lines at Chicago were destroyed by fire on the night of October 4th. Sixteen refrigerator cars were in the barns at the time. The loss is said to have been about $50,000.

E. M. Wilcox has been appointed general car foreman of the Chicago, Indiana & Southern, with office at Gibson, Ind.

STEEL PASSENGER CARS.

(From The Monthly Official Railway List.)

By S. M. Felton, President, Chicago Great Western R. R.

To understand and appreciate the present agitation in regard to steel cars, one must go back to the earlier passenger equipment on our railroads and work up to the present situation through the various changes that have occurred in our passenger train service.

Originally we had light, open platform, wooden coaches, with link and pin couplers, hauled by light engines at slow speeds. These cars answered every requirement in their day and were satisfactory until with the gradual increase in speed, accidents occurred and the telescoping of the open platform cars led to the introduction of the Miller and, later, of the Janney couplers which proved at the time very successful in preventing telescoping in cases of collisions. With the introduction of heavier cars, heavier locomotives and still further increases in speed, these couplers proved insufficient to prevent the breakage of the platforms and the telescoping of the cars.

The next move was the introduction of the narrow vestibule. That accomplished for a time the desired result. With still heavier equipment, especially sleeping cars, the narrow vestibule failed and the wide vestibule, with steel platforms, was adopted and in a number of accidents proved most efficient.

The Pullman Company at this time commenced to strengthen its cars by the use of heavy steel platforms and steel floor construction, extending back beyond the body bolsters of the cars, reinforced by steel corner and door posts and steel transoms, making their wooden car unusually strong, and it seemed to be, and was so regarded, as the strongest and best car construction in the world. Many accidents occurred, and it became a saying all over the country, "Ride in a Pullman car and you will be safer than if you stayed at home."

The speed of trains through this period was constantly increasing and accidents at high speeds necessarily mean greater destruction of equipment. Still, the Pullman car held its own and in accidents, the coaches were generally badly damaged. This led the railroads to build their coaches practically as strong as the sleeping cars, and solid wide vestibule trains on the through routes became almost universal.

Before this period, during the construction of the Pennsylvania station in New York, a very serious accident happened in the subways of Paris, causing a heavy loss of life through the use of wooden cars which caught fire from some defect in the electric installation. The Pennsylvania people having in mind their long tunnel under the Hudson river, concluded to build steel cars for the service in and out of New York with a view of avoiding the possibility of any fire occurring to their trains while passing through the tunnel.

This started the steel car construction; its object being to prevent fire, but a general idea of added strength from the steel construction seemed to enter the public mind and a demand for steel cars immediately sprang up in every direction. Bills were introduced in Congress requiring the railroads to provide steel cars; newspapers discussed the question, and it was generally considered that the steel car was superior, so that down to January 1, 1913, there have been 7,271 passenger equipment cars of steel and 3,296 steel underframe cars built for the various railroads in this country; and since January 1st to July 1st, orders have been placed for 1,064 all steel cars. The construction of wooden passenger cars has practically ceased.

The danger of the wooden cars from possibilities of fire in connection with accidents has been largely removed by the introduction of steam heat and electric lights and the entire absence of any oil or gas. The added strength supposed to be secured from the steel car construction has not been satisfactorily proven, for the reason that with the advent of the steel car very much heavier locomotives were required to haul the trains. These heavier locomotives, with heavy steel equipment behind them, running at high speeds, in case of accident became more destructive than any of the trains in the days of the wooden car; in fact, we have records of the complete destruction of steel sleeping cars in rear-end collisions, and it would be impossible to build a steel car that would resist the shock of a rear-end collision from a train running fifty or sixty miles per hour. It is only necessary for a person to look at the immense Pacific type passenger engines standing in any of our stations and one of the steel cars and consider the result of a collision between them at such speed. There is little doubt but what steel sleeping cars in the recent accident on the New Haven road would have been as completely destroyed as the wooden cars. Nothing could have resisted the impact of the following train running at such a high rate of speed.

It is not the steel car that will produce safety, as many people seem to believe; neither will a complete system of block signals, but the public have a right to demand that on lines of heavy traffic, where fast trains are operated, there should be ample signal protection; that there should be the best equipment that can be provided and that all reasonable safeguards should be thrown around the operation of the trains. But no matter how perfect the signaling, how complete the train, without discipline and the obedience of rules, safety cannot be secured. Only the most competent men should be selected to operate the fast passenger trains. The best men in the service should be selected for the train crews, and the most perfect discipline should be maintained. This is the foundation of safety.

With the heavy equipment and high speed of the modern passenger train, more perfect appliances and more perfect discipline are essential to safe operation. If tomorrow every railroad in the United States were equipped with steel passenger cars, accidents would still continue and, without proper discipline, there would be little improvement in the results. But to refer back to the question of steel cars: Few people realize that it would cost $650,000,000 to provide steel cars for all the passenger service in this country and that in replacing the wooden car with steel, $300,000,000 worth of good serviceable, comfortable equipment would have to be destroyed or sold for scrap. It is estimated that it would take at least ten years, with the present capacity of the car shops of this country, to build steel equipment sufficient for all the roads; and no one has as yet suggested a way to provide the money for this enormous expenditure.

The railroads of the United States today, with few exceptions, are conducting their passenger traffic at a loss because of the very low rates imposed by the laws of many of the states in the Union. The railroads are willing and would be glad to provide better passenger service in every direction if they could only have sufficient revenue to warrant the necessary expenses in connection therewith. The public want the service, dining cars, observation cars, library cars and all the modern comforts of travel; and they should have them. They would find the railroads only too glad to give them everything they are willing to pay for. Recent increases in expenses incident to passenger train movement, such as heavier rails, better ballast, more complete signaling, steel cars, heavier locomotives, and large union stations in the principal cities have all contributed to make the passenger business at rates of even less than those formerly enjoyed by the railroads, an absolute loss.

Let us commence at the bottom and make such reasonable increase in passenger rates as would justify the railroads in providing every known safeguard. Then sustain the railroads in their efforts to enforce as near perfect discipline as possible with human agency; call a halt on the speed mania, and slow down our trains to what might be considered a safe rate of speed. This should make a great improvement in present conditions, but we must all remember that in recent years there has been an enormous increase in passenger business and in speed of passenger trains and with it necessarily an increased risk in operation, which we should endeavor to overcome by all means in our power. The first step must be co-operation between the public, the railroads and the employes as above indicated.

The jurisdiction of D. R. MacBain has been withdrawn from the Chicago, Indiana & Southern and J. T. Flavin assumes charge of the locomotive and car departments.

Twenty Years Ago This Month

A compilation of the greater railway disasters occurring from January to October, 1893, was made by the *Railway Master Mechanic.* In that time twenty-three great wrecks resulted in the death of 198 persons and in the injury of 543 persons. It was estimated that the cost to the railways was approximately $2,000,000. It was urged that this money would have gone far in the equipping of the lines with block signals, then thought too expensive.

In the latter part of 1893, the *Official Railway List,* now *The Monthly Official Railway List,* was subject to a vicious public attack by a competitor, and was defended most effectively in the *Railway Master Mechanic.*

[Editor's Note.—It seems that in 1893, as now, the competitor wishing to attack the *List* did so by showing the omission of logging or private roads in its compilation and also by calling attention to the fact that certain roads of similar nature were included. In other words, the publishers were charged with error if they included this class of roads and again if they did not. This is due to the fact that including or excluding roads of dubious conditions was and is a matter for the judgment of the editors. The "Red List" was then and still is the accepted official reference of its kind. "Out of his own mouth shall he be condemned."]

At the Western Railway Club on October 17, 1893, E. M. Herr read a paper on the locomotives, and Geo. Gibbs, of the Chicago, Milwaukee & St. Paul, on the passenger cars at the World's Columbian Exposition.

Oct. 9, 1893, train Number 7 of the Chicago & Alton, consisting of one engine and twenty-one Pullmans and coaches pulled into the Chicago terminal on time. It carried 1,143 passengers.

On the 14th of October, 1893, the Baldwin Locomotive Works reduced its forces in all departments to less than half the number of a year before.

An official order of the New York, New Haven & Hartford to the heads of all departments, required the immediate discharge of all relatives of said department heads, regardless of circumstances.

President Miller, of the Chicago, Milwaukee & St. Paul, ordered the restoring of all salaries which were effected by a 10 per cent decrease two months previously.

The Mexican Central completed the changing of all its locomotives from coal to wood burners.

Willard Kells was made general foreman of the Erie shops at Meadville.

CORRESPONDENCE.

Editor, *Railway Master Mechanic:* Those that have to do with maintenance of freight equipment are all aware of the weakness of all old equipment, especially the lower capacity cars, which are now generally the oldest handled and which were designed in days when much lighter trains were handled. With the class of power now generally used on all main lines, the necessity for heavier center sills and draft attachments is very apparent. Even the earlier design of steel center sill construction, which did not provide for buckling strains, are frequent cause for considerable expense and apparently not as good as some of the stiffer wooden construction when it comes to resisting buckling strains. The requirements of the present day are such that it is imperative to keep as much of the weaker and older equipment out of each train as possible.

R. D. Hawkins, S. M. P
Great Northern Railway.

Editor, *Railway Master Mechanic:* The question of the retirement from use of cars of 40,000 and 50,000 pounds capacity we believe to be a very important one, and some time since our transportation department was instructed to transfer cars of 40,000 capacity at junction points rather than to handle them over our line, if it was found that the car had to be moved any great distance. In other words we would transfer the car unless it was known that it was to be moved only a short distance over our road, be loaded and returned to the junction point from which it was received. We have not as yet concluded that we should do the same with the 50,000 capacity cars and we realize that the larger capacity cars are not being utilized to their capacity, therefore there is yet a need for the lighter capacity cars. We, however, believe that all roads should be urged to strengthen the draft gear and underframes of their 50,000 capacity cars where it can be done without rebuilding them.

B. H. Gray, S. M. P.
New Orleans, Mobile & Chicago Railroad.

Editor, *Railway Master Mechanic:* We are very much in favor of retiring all 40,000 and 50,000 pound capacity cars from traffic on account of their light capacity and severe treatment which they are subject to when coupled in with heavy modern steel equipment. The Oregon-Washington Railroad & Navigation Company has no 40,000 or 50,000 pound capacity cars in traffic service.

J. F. Graham, S. M. P.
O.-W. R. R. & N.

[The above are the views of a number of railway mechanical men upon the retirement of light capacity cars. This question is of considerable interest at this time and we would be pleased to have others give us their views on the subject.—The Editors.]

THE WELCOME MAN.

There's a man in the world who is never turned down
  Wherever he chances to stray;
He gets the glad hand in the populous town,
  Or out where the farmers make hay;
He's greeted with pleasure on deserts of sand,
  And deep in the aisles of the woods;
Wherever he goes there's the welcoming hand—
  He's the man who delivers the goods.

The failures of life sit around and complain;
  The gods haven't treated them right,
They've lost their umbrellas whenever there's rain,
  And they haven't their lanterns at night.
Men tire of the failures who fill with sighs
  The air of their own neighborhoods.
There is one who is greeted with love-lighted eyes—
  He's the man who delivers the goods.

One fellow is lazy and watches the clock,
  And waits for the whistle to blow;
And one has a hammer, with which he will knock,
  And one tells a story of woe;
And one, if requested to travel a mile,
  Will measure the perches and rods;
But one does his stunt with a whistle or smile—
He's the man who delivers the goods.

One man is afraid that he will labor too hard—
  The world isn't yearning for such;
And one man is always alert, on his guard
  Lest he puts in a minute too much;
And one has a grouch or a temper that's bad,
  And one is a creature of moods;
So it's hay for the joyous and rollicking lad—
  For the man who delivers the goods.

—Walt Mason.

Value of the Drawing Room.

By Lewis D. Freeman, Chief Draftsman, Kansas City Southern Railway.

It is an unfortunate condition that the value of a properly equipped drawing office on railways has for so long been underestimated by the heads of the motive power department, even on the larger roads, while all of the great manufacturing firms depend chiefly upon their drawing rooms for their success.

It is the intention of this article to set forth the advantages of a properly equipped drawing room and point out the results that can and should be accomplished by the efficient operation of the same. This saving is not apparent in concrete form; that is, it does not show on the books of the auditor. It does show, however, in decreased shop expenses and in the amount of stock required for repairs.

Experience has shown that it requires a certain number of men to operate a drawing room, just the same as it requires a certain number of men to operate a freight train. To operate with less than a full crew means a handicap to all concerned and a great reduction in efficiency.

Drawing Room Organization.

The force required to properly operate a drawing room can be reduced to a certain number of men for so many classes of each kind of equipment. For locomotives it requires one first class draftsman for each ten or twelve classes of locomotives. For freight or passenger cars, it requires one first class draftsman for each eight or ten classes. Further, there should be a good shop draftsman for each thirty locomotives turned out of the main shops per month, for the purpose of studying the best and cheapest methods of doing work, to design tools and special appliances for the reduction of cost in performing certain classes of work, and to extend the use of standard tools over the entire system. In addition to draftsmen, there should be a sufficient number of stenographers to handle all correspondence without delay and to take care of the correspondence files, where there is not enough work to keep a file clerk. There should also be a record clerk whose duties should be the keeping of time books, records of tracings, patterns, dies and tools, a general record of all equipment and applications of standard parts to equipment, so that at any time there may be found in the office record the kind of trucks, draft gear, roof, or any important part on any of the equipment, together with a complete record of all failures of parts of equipment. There should be one or more office boys for the making of blue prints, printing titles on tracings and keeping the tracings in their proper places.

Under the direction of a competent mechanical engineer the organization will appear as follows:

Mechanical engineer.
Chief draftsman.
Locomotive draftsmen. Car tracers (if necessary).
Locomotive tracers. Record Clerk. Shop tracers.
Car Draftsmen. Stenographers. Shop draftsmen.
Office boy.

It is desirable to have one tracer for each draftsman on account of so much small work that can be done by the tracers with less expense. On the larger roads employing more than ten draftsmen it becomes necessary to divide into gangs so as to have a leader for each to follow up the work and keep things going. The mechanical engineer of course reports direct to the head of the motive power department.

Duties of the Drawing Room.

The duties of the drawing room are as follows:

1. To furnish blue prints of the latest revision, systematically, to all concerned, of all principal parts of the road's equipment, the same having sufficient information thereon to enable any mechanic to manufacture the parts represented, how to apply them and when to remove as when the safe limit of wear is reached.

2. Keep records of the service obtained and cause of failure of the principal parts of all equipment.

3. Keep records of the application of standard parts to locomotives and cars.

4. Keep records of the failure of all parts resulting in delay to train movement, same to be reported daily, or when parts have to be renewed because of failure with fair usage.

5. Where an engineer of tests is employed, to make up material specifications and take care of the necessary tests of all material purchased to insure getting the proper quality of materials.

6. Where no engineer of tests is employed to make tests of locomotives in road service and promote fuel economy by proper attention to design of locomotives.

7. Standardization of parts of equipment on all present equipment, and the design of new equipment with a view of using as many standard details as possible, provided such parts show by service record that they fulfill the purpose for which designed.

8. Keep complete record of patterns, including name of pattern, number, material of casting, date constructed, date sent and name of foundry, so that by reference to the card bearing a certain pattern number it may be seen at once the location of pattern, and any alterations made, and reference to the drawing number, it is also desirable to have the weight of each casting which may be reported by the store department and entered with pattern record, this is very useful in estimating weight of assembled equipment.

9. The making up of specifications for new equipment should be given enough study and search of the records of failure as outlined above, to insure getting the most serviceable equipment and protect the company from weak and poor designs that require great expenditures for maintenance.

10. The issuing of letters of instruction as to the use of blue prints gotten out for special purposes.

These Results Not Always Obtained.

The above statement shows what should reasonably be expected of a properly equipped drawing room. The reason that these results are not always obtained in everyday practice to the extent to which they should depend on many variable causes, chiefly among which are:

Limitation of staff.
Lack of system.
Incompetent management.
Incompetent staff.
Inability of drawing room to get necessary information from shop and road forces.
First cost being the only consideration in the purchase of equipment, maintenance not considered.
The fact that in some cases the mechanical department is overruled by the higher officers who only consider increased train loads.
Failure of shopmen to follow blue prints, which only results in confusion. For example, a road has a number of duplicate engines and in repairing some change is made in design without the knowledge of the drawing room. This engine fails in service, a new part is ordered and made standard to blue print and will not fit the engine. This is done every day and it does not take long to ruin the interchangeability of the whole lot of equipment. It, of course, can be overcome to a great extent by strict discipline by the proper authority.

There are also a few cases where a mechanical engineer becomes so important, by virtue of his position, that his sole duty becomes the agitating of his working forces, to such an extent that work which should ordinarily take a few hours time takes days and sometimes weeks.

It is beyond the scope of this article to propose a remedy for all of the above causes, where the drawing room fails to perform all of its many duties. Hearty co-operation and support of the head of the motive power department goes far to produce

good working conditions, together with an adequate working force, it remains up to the mechanical engineer to produce the goods.

Drawing Room System.

System in the drawing room is the keynote of successful operation. To begin with, each man must have regularly assigned duties. Drawings should be prepared in standard sizes and be approved as far as possible before making the tracing, which means a great saving in time should changes have to be made. It is a gross waste of time to rush through an important drawing; have it traced and then upon looking into the matter closer to find some important feature that has been overlooked.

In numbering tracings in a railroad drawing room it is desirable to determine by a glance at the number the size of tracing and whether it is used on cars or locomotives or elsewhere. One very convenient way is to select three group letters, as "L" for locomotives, "C" for cars and "M" for miscellaneous drawings, such as shops, tools, etc.

Next comes the determination of the size of tracing. The most convenient size of tracing is 18"x24" and other sizes should be multiples of this size, thus: 18"x24" being size No. 3, and,

9"x12" indicates size No. 1.
12"x18" indicates size No. 2.
24"x36" indicates size No. 4.
12"x36" indicates size No. 5.
24"x over 36" long indicates size No. 6.
12"x over 36" long indicates size No. 7.
Over 24" wide indicates size No. 8.

All tracings over 36" long should be made in even lengths advancing by 6", the maximum length being determined by the length of the filing cases and the capacity of the blue print machine.

For example, L3-101, would indicate drawing number 101, representing some part of a locomotive or tender, the size being No. 3, meaning 18"x24", knowing this, the tracing may be found with a minimum expenditure of time.

Pattern records should be kept in the same manner as outlined for tracings, using the same group letters to show where the pattern is used; this letter being followed by another letter showing the kind of material the castings are made from, together with the serial number of the pattern, thus:

"G" indicating grey iron.
"S" indicating cast steel.
"M" indicating malleable cast iron.

Special alloy metals may further be denoted by the addition of other letters. As brass castings are used sparingly it is seldom necessary to assign a group letter, simply indicate brass by a single letter as "A," for example:

LG-3100 would indicate a casting used on locomotives or tenders, being made from grey cast iron and pattern number 3100. A brass casting would be marked A-100 and would mean pattern No. 100, casting made from brass. The serial number of each group to begin with No. 1, in this manner all groups may be expanded indefinitely without overlapping, as when certain limits for each block of numbers and the same are filled up. This system of numbers can be applied to any shop now having other numbering simply by changing the number when the pattern needs repairs or alteration.

The numbering of tracings can also be changed by assigning new numbers as old tracings are revised from time to time without much additional work.

Reference books made up of all blue prints for a certain class of locomotives or cars are invaluable to the shop people as well as in the drawing room, for by having these reference books the tracings are not handled needlessly.

A small hand power printing press about 6"x9" is a valuable asset to the drawing room. Titles may be set up in type by the office boy and printed in less time than it takes to print a title by hand, with absolute uniformity and only a small fraction of the expense, as the draftsmen can proceed with other work while this is being done. Further, material specification reference can be printed in one corner of the tracing and the title form can, after once being set up, be made in electrotype form, leaving a blank space for name of drawing to be set up by hand each time. This press can also be used for printing small forms, such as a letter blank to send out blue prints to all concerned, to be filled in by hand with the address and name of person, the number and kind of prints and purpose for which they are to be used. The writing of a letter each time can be eliminated by having a receipt attached to be signed and returned by addressee. Thus a record can always be kept of the number and revision letter of all prints, so that there will be no chance for the shop people to say they did not have certain prints as an excuse for not working to them. This outfit can be purchased for about $50.

An electric blue-printing machine is also necessary, so that blue prints may be made at all times regardless of the weather conditions and in much less time than by sun light. The continuous type of machine is to be preferred; that is, a machine that will print any length of print without cutting and pasting the print together. The lamp best suited for such a machine is the mercury vapor lamp. A number of such machines are on the market for a reasonable price.

Drawings may be made uniform by having a standard form or sample drawing showing the relation of different views to each other and leaving plenty of space for title, specification of material, reference to other drawings and notes of instruction. The revision of drawings should be done systematically, care being taken to send prints to all concerned in the change. In order that the change on the drawing may be seen easily and long notes of explanation eliminated, it is suggested to cross out in fine lines the parts superseded, adding the necessary views or new dimensions, placing a revision letter in the title also placing the same letter near each change, having a heavy circle about ¼" in diameter around the revision letter so that the same will stand out above the remainder of the drawing.

A great saving in work can be accomplished by the use of a drawing to represent more than one object of similar design. For instance, say, there are two general styles of driving axles in use, one for main wheels having a place for eccentric fit and one for other wheels not having the eccentric fit. One drawing may be made to represent all the axles on the road, by making two outlines of the different styles of axles and giving letters to the dimensions and making a table on the drawing to show the style of axle, number per engine and the dimensions corresponding to the lettered dimensions. This table then may be extended to cover all engines, saving the work of making a drawing for each. This system may be extended to all details having similar design and only varying in a few general dimensions, saving a great deal of time when necessary to add other details of the same kind.

Personal inspection of the drawing room by the head of the motive power department is also a great help in getting a correct start on new and important work, for it enables a proper understanding of the arrangement desired without spending much time and correspondence.

The preparation of specifications for new equipment should be given sufficient study so that the old records of service and failure of that class of equipment can be looked up and any changes of design made that will increase the efficiency of the equipment under consideration. This is where the greatest return from a properly equipped drawing room is apparent, for it can be determined just what is giving the trouble on present equipment so that the same can be avoided as far as possible in the design of new work. It must be remembered that first cost, while important is not the greatest consideration in getting new equipment, as the same has to be maintained during all the years of service it is expected to give.

Standardization of Equipment.

Every effort should be made to standardize old as well as new equipment, especially castings that have to be kept in stock,

and the study of standardization should be carried even to the smallest details, as every casting saved means less stock to be carried on hand and less money tied up in material. The builders of equipment each have their standard practices that they like to follow, but it is to the advantage of the railway to insist on getting things built to suit their own standards as far as possible and this is ever worth a slightly higher price for the sake of standardization.

Motive Power Meetings.

It is suggested to follow the practice of some roads by having regular monthly meetings held in the office of the superintendent of motive power, for the purpose of openly discussing the betterment of equipment, to be attended by the master mechanics, general foremen, mechanical engineer and leading draftsmen. By the criticism of the practical men in the field, designs may be made standard extending to as many classes of equipment as possible, thus increasing the efficiency of the entire operating staff. A few such meetings will bring out the weak points in the equipment and a means to benefit the same both on old equipment and on any new equipment that may be purchased in in the future. A few such meetings would show some remarkable results, and the practice of maintaining standards would gradually become easy. Take up a few subjects at a time and then extend the practice to all of the smaller details. Complete stenographic record should be kept of all meetings and copies sent to all concerned. The expense of maintaining such a drawing room organization will soon begin to appear in the form of better condition of equipment, and less cost of maintenance as well as in the amount of material carried on stock for repairs. On every road there are numerous classes of equipment that with a little study may be made interchangeable to some extent at least, and it should be remembered that "every little bit helps" to keep the operating expenses down to a minimum.

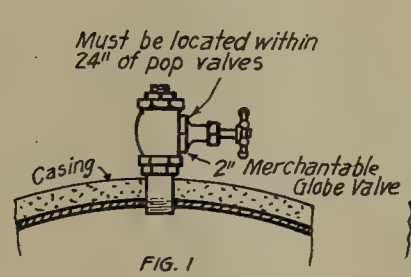


FIG. 1

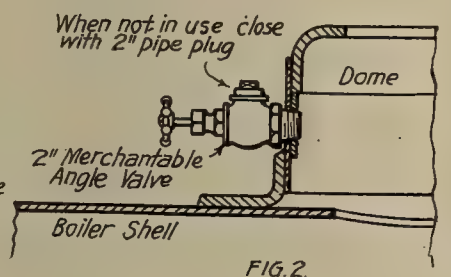


FIG. 2.

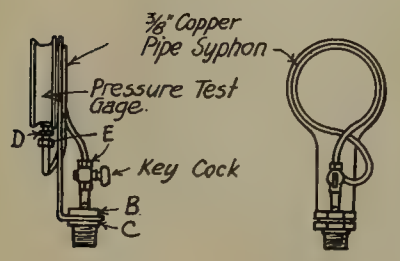
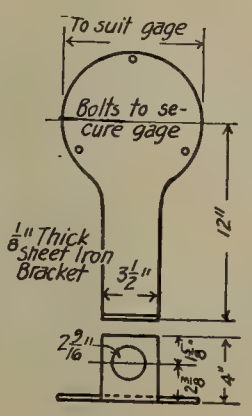


FIG. 3.



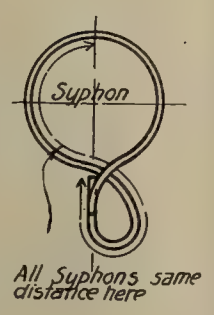


FIG. 4.

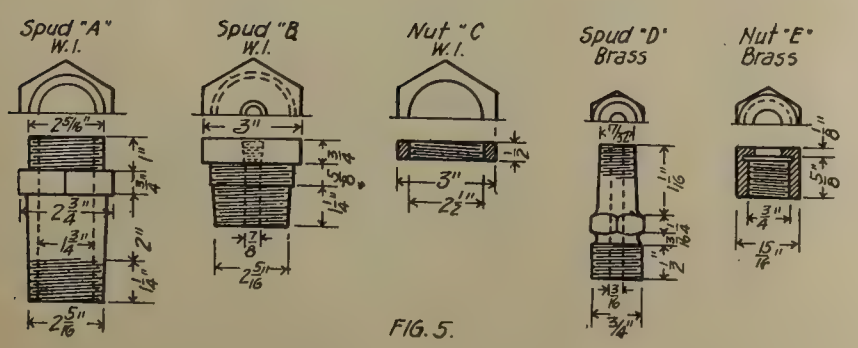


FIG. 5.

Pop Valve Test and Gauge Fittings.

POP VALVE TEST AND GAUGE FITTINGS.

By Alden B. Lawson, Baltimore, Md.

Since the Federal laws insist on a test gauge being within the vision of the person testing the pop valves on locomotives, it has been found very difficult to get this gauge to register with the regular steam pressure gauge in the cab; and below is given what we believe to be the best arrangement obtainable and which has been adopted after quite extensive experiments by one of the prominent railways of the country.

When engines are in shop for repairs both the pop valves and the pressure gauges are repaired and tested with a standard master gauge, and therefore it is not necessary to try either of these with the test pressure gauge at that time, as the pops may be checked with the regular pressure gauge, and if it does not relieve at proper pressure called for, then it should be looked into and a correct test gauge applied to see which is wrong—the pops or the regular gauge.

This test gauge will be of more service at the terminals and roundhouses, in trying pops and pressure gauges after they have been in service the allowable time permitted by law.

As the law calls for this test gauge to be within twenty-four inches of the pop valves, it was decided to either place a two-inch angle valve in the dome or a two-inch globe valve in the roof of the boiler shell, and arrange to connect the test gauge to these. These valves also could be used to blow off the steam when necessary to relieve the boiler of steam pressure only.

Figures 1 and 2 show the globe valve and connection to boiler, and angle valve in dome.

Each engine is equipped with either the device shown in figure 1 or figure 2, using that one most desirable for the location of the pops.

The test gauge is arranged on a sheet-iron bracket and equipped with the proper fittings. It is not very heavy, and can be readily carried around. There is no necessity to have more than two of these at any one station, and for the small terminals one should be sufficient. Figure 3 shows test gauge complete ready to connect to the angle or globe valves as shown by figures 1 and 2.

The syphon shown in figure 4 should be the same dimension from gauge connection to highest part of syphon, for both the test gauge and regular pressure gauge, and this should be exact to obtain the same register for both gauges. The rest of pipe can be as long as necessary to connect up to steam cock. A syphon of any shape may be used, but care must be taken to see the syphon portion next to gauge is same in all cases.

Special attention should be given to the test gauge and it should be checked up by master gauge not less frequently than once every ten days.

Figure 5 shows the several details used in connecting up test gauge to globe valve and angle valve, and also connects globe valve to boiler.

THE CANADIAN PACIFIC has started a car out for a trip over the system for the purpose of giving instructions in first aid to the injured. An instructor accompanies it and it will lay over at the various terminal points for periods of from one to three weeks.

THE MISSOURI & North Arkansas has recently completed and put in operation new shops at Harrison, Ark. The machine shop is 238 feet by 70 feet, has three inspection pits, reinforced concrete pilasters and wooden roof trusses. The storehouse is 46 feet by 84 feet and contains the offices of the storekeeper and master mechanic. There is also a wood mill 40 feet by 77 feet, a car repair shop 48 feet by 108 feet, a coach shop 40 feet by 80 feet, a power house, 29 feet by 82 feet, a 6-stall roundhouse, a 45 foot concrete cinder pit, a 100,000 gallon concrete water tank and an office building for the operating department. The shop machinery is driven by individual motors. Construction work was commenced March 15, 1913, and finished October 1, 1913, the total cost of the job, which included five miles of track, being $150,000.

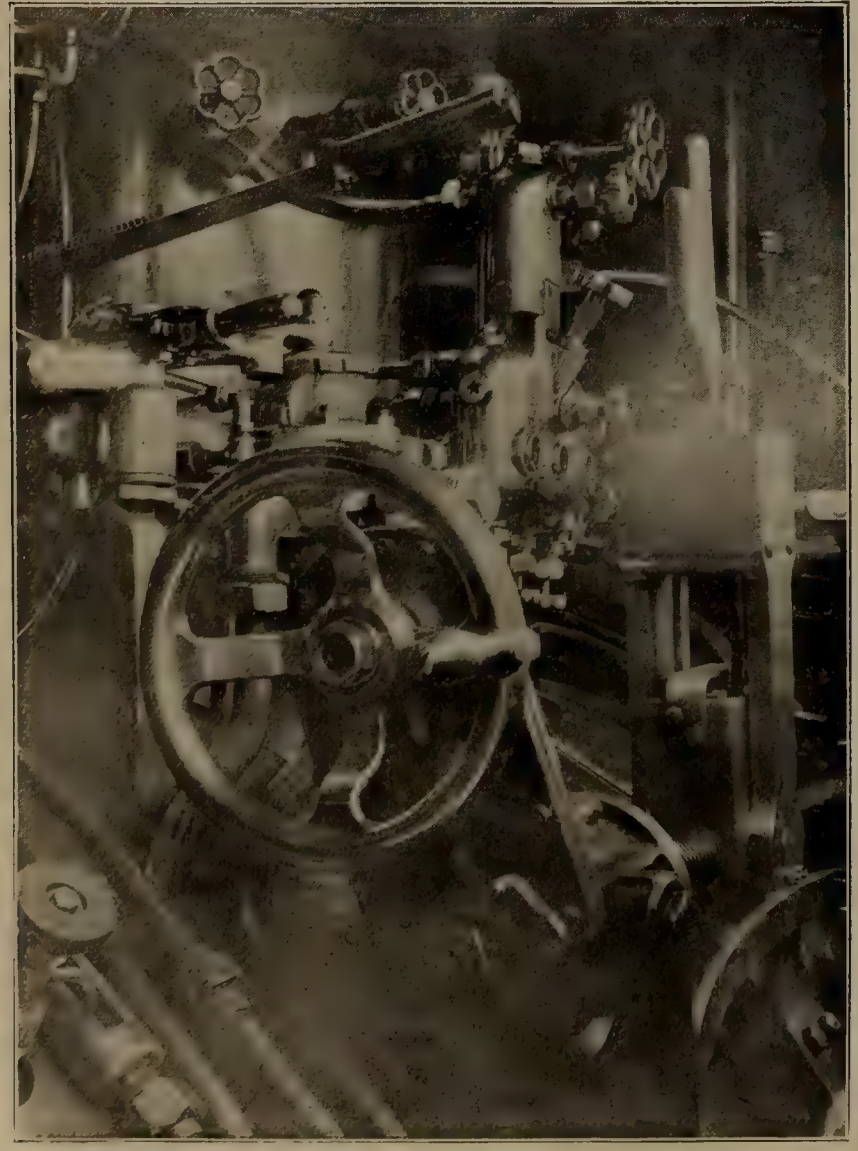
INSPECTION LOCOMOTIVE, P. & R. RY.

An inspection locomotive of the Atlantic type has recently been turned out at the Reading shops of the Philadelphia & Reading. On account of the purpose for which the locomotive is to be used, the boiler shell is exceptionally small and is equipped with a Wooten firebox with a crown sheet about on a level with the door. The steam dome is 34 inches in height by 27½ inches in diameter and is located in the cab. The engine is not equipped with a superheater but has 180 1¾-inch tubes 14 feet in length and has a grate area of 63 square feet. The steam pressure is 225 pounds. The Walschaerts valve gear is used and on account of the fact that the boiler is set low, special means had to be devised for the connections to the reverse lever and the lift shaft had to be deviated from a straight line. The steam cylinders are 18 x 24 inches and are equipped with piston valves. The steam pipe extends straight from the smoke box to the steam chests, underneath the floor of the observation compartment.

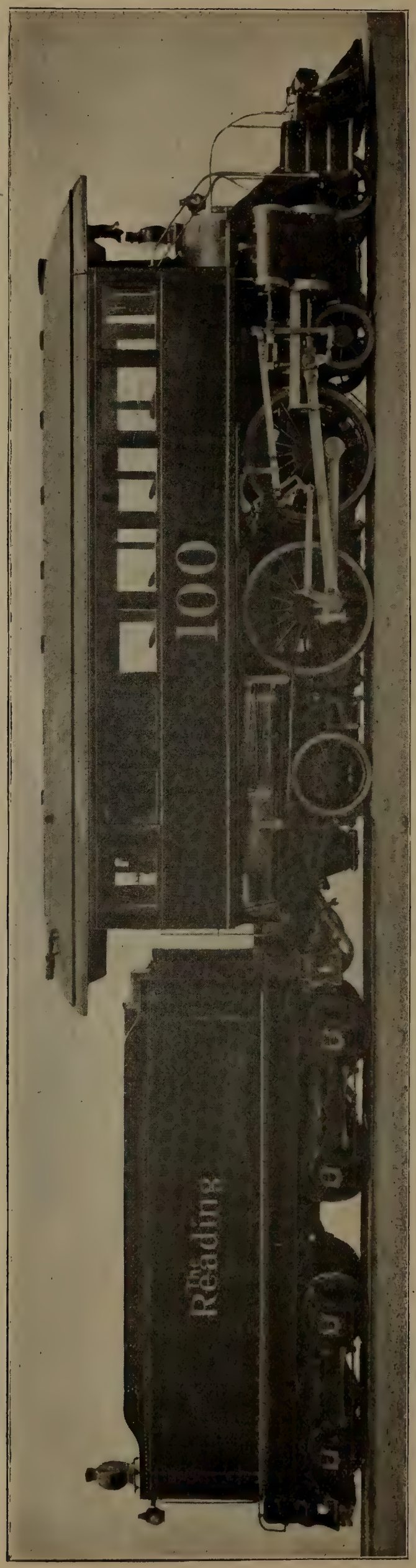
One of the illustrations shows the combination screw and lever reverse. The reverse lever spans the screw and as will be noted has a block which engages one-half of the threads of the screw. By turning the screw the lever can be moved as desired. The hand wheel operates the screw through a train of gears and the whole mechanism is pivoted to a casting fastened to the boiler. This was necessary in order that the screw mesh properly with the block in the reverse lever in its various positions. A guide at the front end keeps the screw in line.

Emergency brake valves are provided in the observation room and push buttons provided for communicating with the engineer. A wash room is located in the cab. A turbo-generator supplies current for electric lights and provisions are made for heating the observation room when necessary. The engine has power enough to haul two cars if it is desired.

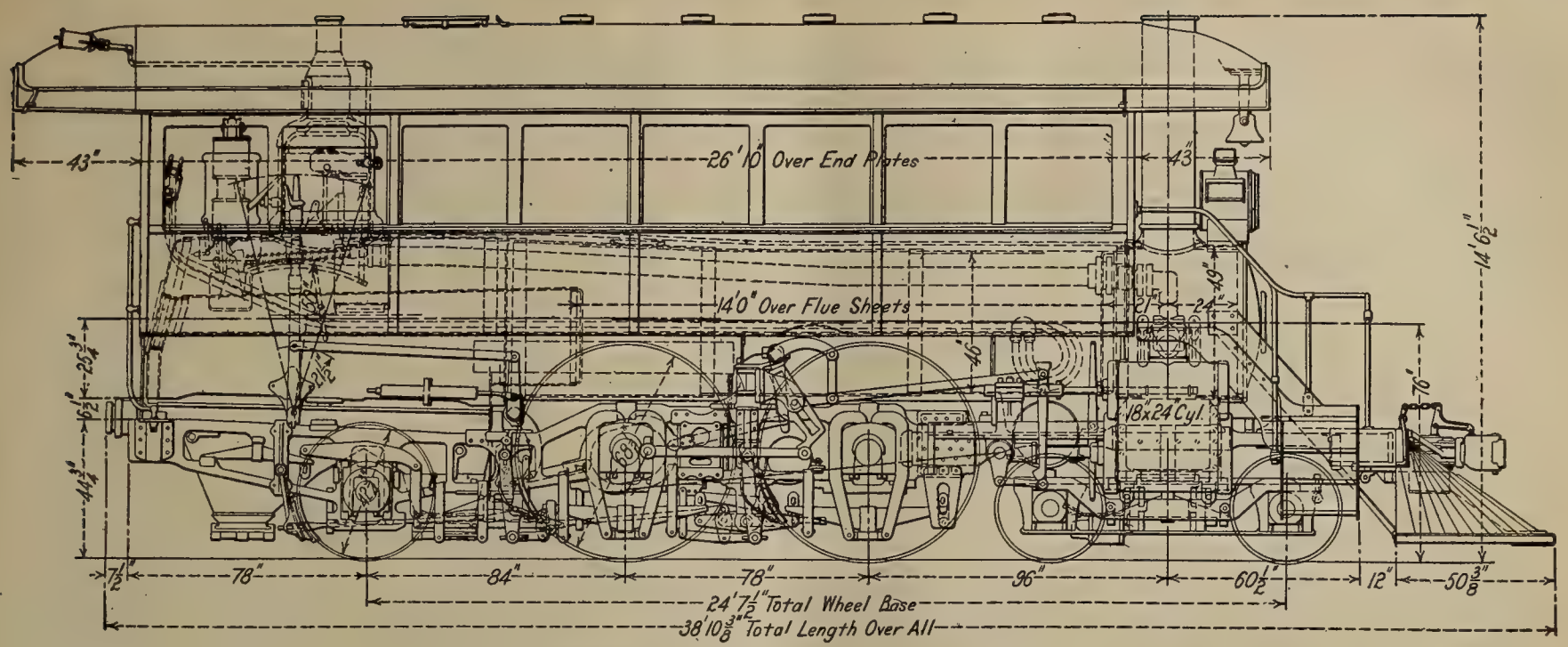
Following is some general data with regard to the engine:



Combination Lever and Screw Reverse Gear.



Inspection Locomotive Built at the Philadelphia & Reading Shops.



Elevation of P. & R. Inspection Locomotive.

Tractive power	21,700 lbs.
Weight in working order	161,500 lbs.
Weight on drivers	98,375 lbs.
Weight on leading truck	26,775 lb.
Weight on trailing truck	36,350 lbs.
Weight of engine and tender in working order	299,500 lbs.
Wheel base, driving	6 ft. 6 in.
Wheel base, total	24 ft. 1½ in.
Wheel base, engine and tender	53 ft. 5½ in.
Cylinders	18 in. x 24 in.
Valves, diameter	11 in.
Valve travel	7 in.

Wheels.

Driving, diameter over tires	68½ in.
Driving journals, main, diameter and length	8½ in x 12 in.
Engine truck wheel, diameter	33 in.
Engine truck journals	5½ in x 10 in.
Trailing truck wheels, diameter	42¾ in.
Trailing truck, journals	7 in. x 12 in.

Boiler.

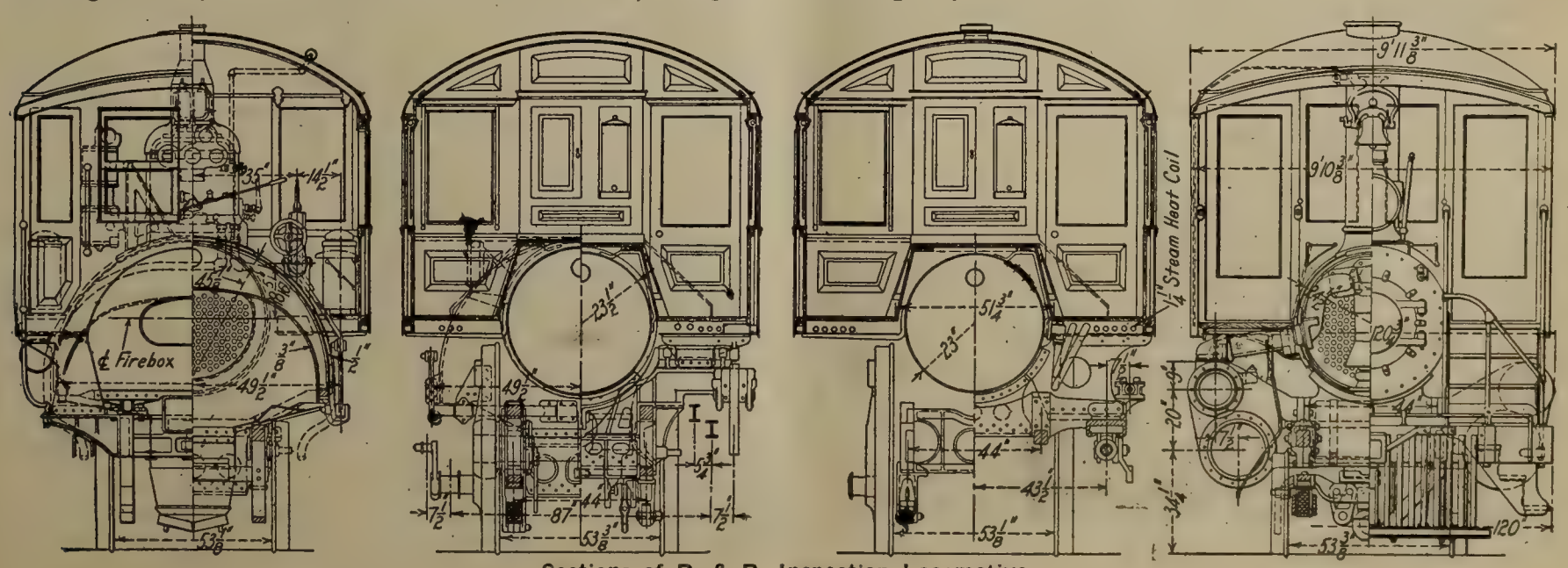
Style	Wooten
Pressure	225 lbs.
Outside diameter of first ring	46 in.
Firebox, length and width	108 in. x 84 in.
Tubes, number	180
Tubes, outside diameter	1¾ in.
Tubes, length	14 ft.
Heating surface, tubes	1,154 sq. ft.
Heating surface, firebox	120 sq. ft.
Heating surface, total	1,274 sq. ft.

Observation Room, P. & R. Inspection Locomotive.

Grate area	63 sq. ft.
Center of boiler above rail	76 in.

Tender.

Frame	12 in. channel
Wheels, diameter	36 in.
Water capacity	6,000 gals.
Coal capacity	9.75 tons



Sections of P. & R. Inspection Locomotive.

Ratios.	
Weight on drivers ÷ tractive effort	5.13
Total weight ÷ tractive effort	8.41
Tractive effort × diam. drivers ÷ heating surface	1,032.0
Evap. heating surface ÷ grate area	20.22
Firebox heat. surface ÷ total evap. heat. surf., per cent	10.61
Weight on drivers ÷ total heating surface	77.20
Total weight ÷ total heating surface	126.7
Volume, both cylinders, cu. ft.	7.06
Total heating surface ÷ vol. cylinders	180
Grate area ÷ vol. cylinders	8.92

FURNACE FUEL COSTS.

Data on the comparative costs of fuels for shop furnaces has been prepared by Tate, Jones & Co., of Pittsburgh. Some of the results of an analysis of the situation as made by this concern are given below:

In general the cost of oil in the tank, of coal in the bin, or natural gas delivered is used as the sole criterion of the economic status of the plant but in most cases this is not accurate.

An analysis will show, that what are usually considered the "incidental" expenses, which are necessary for the proper handling and burning of the fuel, far outweight the fuel cost.

Of course before considering the cost at all, the shop superintendent wants to know "will this fuel do my work and do it as fast and the way I want it done?"

With coal or coke burned directly in the furnaces the time lost building and tending to fires must be considered, also the fact that they give a much slower fire or heat than the gaseous or liquid fuels.

Besides these disadvantages, there is all the handling of the fuel and the ashes to be considered, and the fact that with gas or oil this is not necessary and your shop is much cleaner and more efficient.

Powdered coal approaches a gaseous fuel as the coal is pulverized very finely and blown into the furnace so that it is practically a combustible gas. The requirements, however, for successfully burning powdered coal are such as to make it impractical for anything but the larger type of furnaces. It requires very expensive installations of pulverizing machinery conveyors, etc., and it must be projected into a chamber hot enough to cause instant ignition. This means for every furnace, some independent means of heating as an oil or gas burning system for warming the furnaces up. Each furnace requires a separate stack and due to excess wear on linings, etc., it is impossible to burn it in furnaces much smaller than large puddling or billet heating furnaces, etc.

A liquid or gaseous fuel is the ideal fuel for most industrial furnace work because with them quick heats can be obtained, absolute control of the temperature is possible and a large increase of output over furnaces using solid fuel is achieved.

Therefore in the following comparisons we will only consider the liquid (fuel oil) and gaseous (natural and producer gas) fuels.

In this comparison both fuel cost and total operating cost must be considered as both these items determine fuel cost per unit of output. The items entering into this consideration are as follows:

1. Cost of fuel.
2. Cost of plant.
3. Cost of erection.
4. Floor space or building required.
5. Interest on investment.
6. Taxes.
7. Depreciation and Repairs.
8. Labor required to operate.
9. Power needed for auxiliaries.
10. Cost of water.
11. Reliability.

1. Cost of Fuel.

The following comparative cost is figured allowing 80 cu. ft. of gas from 1 pound of coal gasified and 125 B. T. U. per cu. ft. of producer gas, 1000 B. T. U. per cu. ft, for natural gas and 144,000 B. T. U. per gal. of oil.

Oil per gal	Prod. gas from Coal per ton	Nat'l gas 1000 cu ft	B. T. U. for 1c
2c	$2.55	14c	72000
2½c	3.30	17c	57600
3c	4.00	21c	48000
3½c	4.65	24c	41200
4c	5.30	28c	36000
4½c	6.05	31c	32000
5c	6.70	35c	28800

This comparison is on a B. T. U. value only and does not take into consideration any of the "incidental expenses."

2 and 3. Cost of Plant and Cost of Erection.

These will be considered together as the plant must be erected to operate.

In order to compare these costs we must know the equivalent sizes of each installation. From a producer manufacturers catalog comparing producer gas with oil fuel for furnace work, we quote the following, "in most cases 12 H. P. will be found to be equivalent to 1 gallon of oil."

Figured on this basis we have the following equivalent sized plants:

Size of Gas Producer	Size of Oil Burning Plant	Amount Nat. Gas
480 H. P.	40 gallons per hour.	5760 cu. ft.
720 H. P.	60 gallons per hour.	8640 cu. ft.
1440 H. P.	120 gallons per hour.	17280 cu. ft.
1920 H. P.	160 gallons per hour.	23040 cu. ft.

Producer gas for small furnace use has to be piped often in small pipes and considerable distances, the gas must therefore be free from dust, moisture and tar. Gas producers, either double zone or pressure type, will cost, erected with auxiliaries, at least $20.00 per H. P. for the two smaller sizes and $15 per H. P. for the others.

The erected costs of the different systems would be then as follows:

Producer	Equivalent Oil Plant	Equivalent Natural Gas Plant
480 H. P. $ 9600	$1250	$275
720 H. P. 14400	1500	375
1400 H. P. 21000	1900	500
1920 28700	2500	700

4. Floor Space.

A comparison of the space occupied by the different installations brings out another incidental expense.

Taking the rated capacities compared above, the floor space and head room needed by plants of the same capacity is shown by the tables below.

Capacity	Floor Space Producer	Oil	Nat. Gas
480 H. P. or 40 gal.	55′x 26′	6′x 6′	4′x 6′
720 H. P. or 60 gal.	60′x 35′	8′x 8′	4′x 8′
1440 H. P. or 120 gal.	60′x 48′	10′x 10′	5′x 10′
1920 H. P. or 160 gal.	60′x 62′	10′x 10′	5′x 10′
	Head Room.		
480 H. P. or 40 gal.	26′	6′	5′
720 H. P. or 60 gal.	26′	6′	5′
1440 H. P. or 120 gal.	26′	6′	5′
1920 H. P. or 160 gal.	26′	6′	5′

The figures on space for the producer plant are for a double zone bituminous producer. For a pressure producer the space required would be about the same, while for an anthracite suction gas producer a little less space is required.

With the gas producer installation considerable space is required for the storage of coal and, in many cases, coal handling machinery is necessary owing to the height fuel has to be elevated to feed the producer. In oil burning installations the oil is stored in tanks, underground, taking up no room in plant proper, and fuel is easily handled by pumps so that above

dimensions give practically all the floor space required. Of course with natural gas storage of fuel is eliminated and only space required is for motor or belt-driven fan outfit.

Floor space occupied is an item in the cost of a plant, especially if a new building is required.

Where land is high priced or where a new building has to be erected to house, either installation, the saving in favor of the oil installation over the producer plant will be very marked.

5. Interest on Investment.

At a rate of 5% the saving in interest on an oil installation over a gas producer plant is also very marked.

6. Taxes.

Taxes in both cases are proportional to investment. Here again space occupied must be considered. The showing again is in favor of oil.

7. Depreciation and Repairs.

Taking the same rate of depreciation for both installations, we have another "incidental" expense in favor of oil.

The depreciation of the producer plant, however, is more rapid than the oil installation, also the repair charges are greater. In the producer plant the auxiliaries are more extensive and the wear and tear on them is much worse than the oil installation where there is nothing but the pumping and blowing outfits to look after.

8. Labor.

In producer installations for the sizes under consideration a gas maker and helper would probably be required, as considerable coal has to be handled, ashes removed, and fuel bed kept in good operating condition. The making of producer gas depends upon chemical reactions between the fuel, steam and air, and as quality must remain constant an ordinary laborer can not be trusted to operate a gas producer. Practically no labor is required in an oil burning installation. The handling of fuel is all done by the pumping system. Oil is run directly from car to storage tank, which is usually underground, and pumped from tanks to burners as needed. Fans and compressors are usually operated by motors, so very little labor is needed beyond the daily looking over that every installation should have, which can be done by the furnace tender or plant engineer.

Labor Cost of Operating.

	Producer	Oil	Natural Gas
Gas Maker @ $3 per day	$3.00	0	0
Helper @ $1.50 per day	1.50	0	0
	$4.50		
Cost per year, 300 days	$1350.00	0	0

9. Power Needed for Auxiliaries.

The auxiliaries required for a gas producer installation include an exhauster, compressor, pumps, blowers, etc., while for an oil installation all that is required is a pumping system for the oil and a fan or compressor, or both, to furnish air for atomization and combustion of the oil. In the natural gas installation all that is required is a fan to furnish air for combustion of the gas.

Horse Power for Auxiliaries.

Capacity	Producer	Oil	Natural Gas
480 H. P. or 40 gal./hr.	30	8	5
720 H. P. or 60 gal./hr.	43	12	7½
1440 H. P. or 120 gal./hr.	86	24	10
1920 H. P. or 160 gal./hr.	115	37	15

For pressure producers where rotary extractors are used at least 3% of H. P. developed will be required for the rotary. The above tables show that the power for operating auxiliaries in producer plants is over 3 times greater than the power required for oil burning plants, therefore operating cost of auxiliaries will be three times greater.

10. Cost of Water.

Water is a large item of cost in producer plants. The usual allowance is from three and one-half to five gallons per H. P. per hour for cooling and cleaning the gas. If the water is allowed to run to waste the expense is great, and if used again and again it means the installation of settling basins and cooling towers with an additional pumping plant. This expense is entirely saved in oil installations.

11. Reliability.

Reliability in producer plants rests largely upon (a) coal used and (b) gas maker.

(a) If coal is free from caking and clinkering qualities, a gas of good quality can usually be made, but if a caking coal is used or the coal clinkers badly, poor gas results, or the plant must even be shut down from time to time to remove clinkers. (b) Producer gas is the result of a heat and chemical process, so the reliability depends to a large extent on the ability and judgment of the gas maker to properly regulate the fuel bed and the amount of air or steam admitted to it. A good gas maker can usually make a gas of constant quality, while a poor one may vary greatly the quality of gas produced.

As quality of oil is a constant, and any kind of oil, from light distillates to the heavy Texas or Mexican oils, can be burned by an oil installation, the item of reliability is in favor of the oil.

However, where natural gas can be obtained in sufficient quantities at a reasonable figure, neither oil nor producer gas can compete favorably with it in matter of cost, although there are some places where an oil fire is superior to a natural gas one at any figure.

Let us, for an example, figure out the actual yearly cost of a plant operating on producer gas and compare with one operating on fuel oil.

COMPARATIVE COST OF OIL AND PRODUCER GAS

Items	Producer	Oil	Remarks
No. 1 Fuel 1.25 lbs. coal per H.P. 1440×1.25=1800 lbs. coal per hour 9×1800×300=4860000 lbs. coal per year 4860000÷2000=2430 tons @ $4=.....	$9720.00		
120 gal. per hour 120×9×300=324000 gal. @ 3c=.....		$9720.00	
No. 2 & 3 Cost of Plant			Prod. $21000 Oil 1900
Saving in first cost of oil installation over producer plant.....			.....$19100
No. 4 Floor Space			Prod. 60′×48′×26′ Oil 10′×10 × 6′
No. 5 Interest 5% of 21000=.....	1050.00		
5% of 1900=.....		95.00	
No. 6 Taxes 1.5% of ¾ of 21000=.....	236.00		
1.5% of ¾ of 1900=.....		21.00	
No. 7 Depreciation & Repairs 10% of 21000=.....	2100.00		
8% of 1900=.....		162.00	
No. 8 Labor See Table=.....	1350.00	00.00	
No. 9 Power and Auxiliaries 86 HP×9×300=232200 HP hrs. 232200×.746=173221 KW hrs. 173221×5c=.....	8661.00		
24 HP×9×300=64800 HP hrs. 64800×.746=48340 KW hrs. 48340×5c=.....		2417.00	
No. 10 Water 4 gal.×1440=5760 gal. per hr. 5760×9×300=1555200 gals. 1555200 @ .05c.....	778.00	00.00	
Total cost for 46656 million B. T. U.....	$23895.00	$12415.00	
B. T. U. for 1c.....	19500	37500	

Take from the table under item 1 oil at 3c per gallon, which is equivalent in B. T. U. to producer gas from coal at $4.00 a ton.

This is figured on the basis of a 1440 H. P. producer plant, which is equivalent to an oil installation to burn 120 gallons per hour.

This example shows how little value can be placed on B. T. U. comparisons, as fuel cost is only a part of the total cost of successful burning.

SUB-BITUMINOUS AND LIGNITIC COAL AS LOCOMOTIVE FUEL.*

Samuel B. Flagg, Engineer, Dept. of the Interior.

The varied problems of fuel utilization to be met and solved by our large railway systems today call for not only a proper anticipation of the demands for fuel and judicious purchasing of it, but also for the best design of equipment and proper methods of operation if fuel costs are to be kept down. Availability is one of the principal factors governing the cost of fuel for any road, and for this reason largely some roads or divisions are using wood, others are using oil, and still others anthracite, bituminous, sub-bituminous, or lignitic coals or coke. In some foreign countries peat has also been tried, but, so far as the author knows, without great success.

With the consolidation of the smaller roads into the large railway systems greater attention has been given to economies of operation, and, because of the importance of the fuel item, it is but natural that this item has been given such serious consideration. The effort to reduce operating costs has resulted, on the one hand, in a demand for much more powerful locomotives, and, on the other hand, in a tendency to utilize lower grades of fuel, among which may be mentioned the lignitic and sub-bituminous coals found in certain sections of the country. It is the purpose of the present paper to describe briefly and in a general way the deposits of the latter coals and to show what methods have been and are being employed to utilize these fuels in locomotive practice.

Unfortunately the dividing line between lignitic and sub-bituminous coals and also between sub-bituminous and bituminous coals cannot be sharply drawn. In general, however, lignitic coals are characterized by a high moisture and high volatile matter content, by a fairly low percentage of ash, and by a low heat value. They are of a brownish color, have a woody appearance as regards their structure, and give up their moisture and disintegrate rapidly upon exposure to the atmosphere.

The lower grades of sub-bituminous coal differ from the lignites mainly in their appearance, as is indicated by the designation "black lignites" that is frequently given them. These lower grades of sub-bituminous coal, like the lignite coals, are high in their moisture and volatile matter contents and low in heating value. Their behavior upon exposure to the air is also similar to that of the brown lignites, but the structural resemblance to wood is much less marked and, in many cases, is absent, the better grades of these sub-bituminous coals, on the other hand, have a much lower moisture content and higher heat value; in fact, the heat values of some of them are considerably higher than those of many of the bituminous coals. Even these high grade sub-bituminous fuels, however, have the same tendency to disintegrate upon exposure to the air, and the same is true upon exposure to heat in a furnace. Another characteristic feature of both the lignitic and sub-bituminous coals is their liability to heat in the pile or bunker and to take fire spontaneously. This difficulty is experienced with many of the bituminous coals as well, but is not so uniformly encountered with such coals as with the lower grade fuels.

A few typical analyses of fuels from some of the different fields are given in the table below, the last two being classed by the U. S. Geological Survey as medium grade bituminous or lignitic coals. Certain of these analyses were supplied by different railroad companies and in such cases the initials of the road supplying the information are given. The Bureau of Mines is authority for the other analyses.

Proximate Analysis.	Gebo, Bighorn Co., Wyo., Slack Coal. (Sub-Bit.)	Hannah, Carbon Co., Wyo. (Sub-Bit.) U. P. R. R.	Hudson, Fremont Co., Wyo. (Sub-Bit.) C. & N.-W. Ry.	Roundup, Musselshell Co., Mont. (Sub-Bit.) C. M. & St. P. Ry.	Erie, Weld Co., Colo. (Sub-Bit.) U. P. R. R.	Gallup, McKinley Co., N. Mex. (Sub-Bit.) Lump, Nut and Slack.	Williston, Williams Co., N. Dak. (Lignite).	Rock Springs, Sweetwater Co., Wyo. (Bit.) U. P. R. R.	Superior, Sweetwater Co., Wyo. (Bit.) U. P. R. R.
Moisture	16.58	6.72	8.37	7.83	15.84	11.90	42.88	7.32	7.40
Vol. Mat	31.97	45.06	41.10	32.66	34.55	37.85	24.22	39.83	40.17
Fix. Car	46.05	39.51	48.02	53.63	43.95	41.57	24.96	45.37	46.95
Ash	5.40	8.05	3.51	5.88	5.34	8.68	7.94	6.42	4.57
Sulphur	.64	.66	.38	.22	.32	.56	1.53	1.06	.91
B. T. U.....	10609	11462	.....	12771	10215	11077	5683	12017	12283

It has been estimated that of the coal easily accessible and still remaining in the coal fields of the United States one-third is represented by the lignitic and sub-bituminous deposits. The principal beds of these coals are found in Texas, North Dakota, South Dakota, Montana, Wyoming, Colorado, New Mexico, and Washington. Other deposits of lesser importance occur in Arkansas, California and Oregon. Because of the availability of bituminous coal or oil the development of the deposits of these lower grade coals in Arkansas, Texas, California and Oregon has been retarded, and likewise in some other parts of the fields the proximty of deposits of the better sub-bituminous fuels has discouraged the mining and use of lignites. The fields of the lower grade coals commercially most important today are those in Montana, Wyoming, Colorado, New Mexico and Washington. In the two states first mentioned, however, much of the fuel that is generally termed sub-bituminous is either medium grade bituminous or else it is so near the dividing line between the two classes of coals that it is difficult to classify.

Of the sub-bituminous fields in Montana the most important are the Bull Mountain field in Musselshell County south of Roundup, and the Red Lodge field in Carbon County near Red Lodge. The output from these fields is classed as high-grade sub-bituminous and amounts to approximately two million short tons per annum, or something over one-half of the state's production. Statistics relative to the production of coal in Wyoming do not show just what proportion of the product was of the lignitic and sub-bituminous classes, but it was less than one-half. According to the U. S. Geological Survey, the principal centers of production of sub-bituminous coal in Wyoming are Black Buttes, in Sweetwater County; Hannah, in Carbon County; Sheridan, in Sheridan County; Glenrock in Converse County, and Gebo in Bighorn County. In the Colorado field the most of the sub-bituminous production is in Boulder, Jefferson and Weld Counties, not far from Denver, while McKinley County is New Mexico's principal source for this grade of fuel. From the statistical information which the author was able to get, it is not possible to tell what proportion of the coal production of the state of Washington

*A report before the fifth annual convention of the International Railway Fuel Assn.

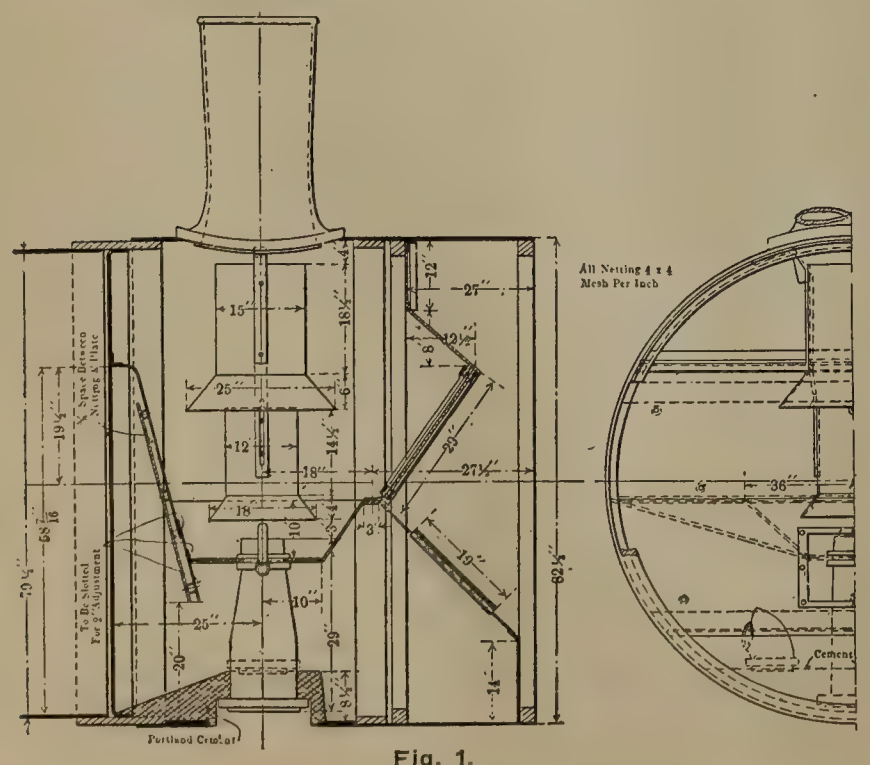


Fig. 1.

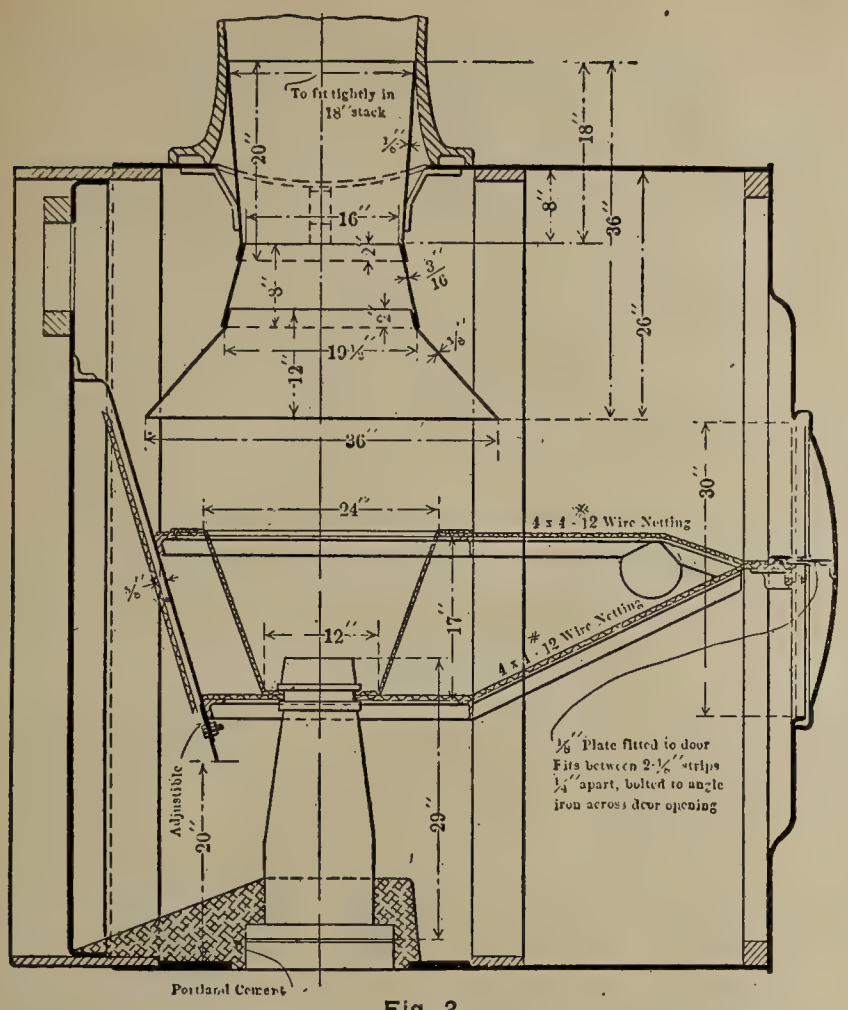


Fig. 2.

was of the sub-bituminous grade. It is believed, however, to be not a large percentage. The principal mines producing this grade of fuel are in King county.

Mining costs in the different fields producing sub-bituminous coals vary considerably, probably ranging between eighty cents and one dollar and seventy cents per short ton as extreme values. These costs, of course, are proportionately higher where the output is small than where the development has been more extensive. They are also affected by the character of roof and other physical mining conditions, by the cost of timber for props, and by the prevailing scale of wages. Some idea as to the costs of production in some of the sub-bituminous and some of the bituminous fields can be gained from the following figures:

Location of deposits—	Production cost per ton
Carbon County, Mont. (Sub-bituminous)	$1.40 to $1.60
Bighorn County, Wyo. (Sub-bituminous)	1.10 to 1.40
Sheridan County, Wyo. (Sub-bituminous)	.70 to 1.38
Boulder District, Colo. (Sub-bituminous)	1.05 to 1.10
Gallup District, N. Mex. (Sub-bituminous)	1.25
Illinois Field (Bituminous)	.85 to 1.40
Pennsylvania Field (Bituminous)	.85 to 1.25
West Virginia Field (Bituminous)	.87 to .90

The tendency of both the types of low-grade fuel to disintegrate upon exposure to the air has already been mentioned, and it is unnecessary to point out to the members of this association the desirability of keeping as low as possible the percentage of slack in locomotive fuel. Because of the disintegrating effect of heat upon these coals, however, it is especially important that the coal in the tender should contain little slack. Nearly all of the sub-bituminous coals suffer more or less seriously from breakage also, unless carefully handled in the screening and loading processes. The importance of careful handling is in many cases overlooked, but some producers are now replacing the high tipples with lower ones and are installing shaking screens in order to reduce the breakage. In the loading of either open or closed cars similar precautions may be taken by using an apron on the screens or the car-loader so that the coal has less of a fall.

Opinions seem to differ as to the necessity for shipping these fuels in closed cars when intended for railroad use. Some are of the opinion that the wetting or air-slaking of coal shipped in open cars penetrates but a few inches below the surface and does not seriously impair the value of the fuel for locomotive service, while others claim that the deterioration is sufficient to make shipment in box cars practically imperative. The cost of loading and unloading cars under the latter conditions is obviously greater than when gondola or drop-bottom cars are used. The author has little data as to what the increased cost of the coal amounts to, but figures obtained from three authorities range from four to ten cents per ton of coal. This is probably offset to some extent by the prevention of loss of coal in transit. In the regions where these sub-bituminous coals are used domestic fuel prices are usually high and many complaints have been made about loss of coal between the mine and the dealers' yards. It is possible that some of the members may have some figures showing what this loss amounts to.

The same differences of opinion which have been mentioned in connection with the shipment of sub-bituminous coals in open or closed cars obtain in relation to the possibility of storing them advantageously. The question of storing such coals involves not only the slaking and the deterioration resulting therefrom, but also the liability of spontaneous combustion. It is held by some that sub-bituminous coals can be stored for periods ranging from eight months to a year without impairing their value for locomotive use, but others state that storage for any length of time is impracticable and that the fuel must be used soon after it is mined. The author's limited experience with coals of this type leads him to the belief that they may possibly be stored for a short time without serious deterioration from the standpoint of their steaming value in locomotive use, but that the coals which are not impaired after storage for a year are more likely medium grade bituminous coals than either sub-bituminous or lignitic.

The liability of spontaneous combustion, although greater for the lignitic fuels, is considerable in the case of the sub-bituminous coals and dust or slack must not be allowed to accumulate. One member states that coal chutes should be swept twice monthly in order to keep to a minimum the danger from fires, but that with such precautions the risk is not great.

The substitution of these low grade coals for bituminous fuel introduces, in addition to the difficulties already mentioned, a number of problems of operation. Because of the generally lower heat value and the difficulty of realizing this value in the firebox it is obvious that a much larger quantity of coal must be

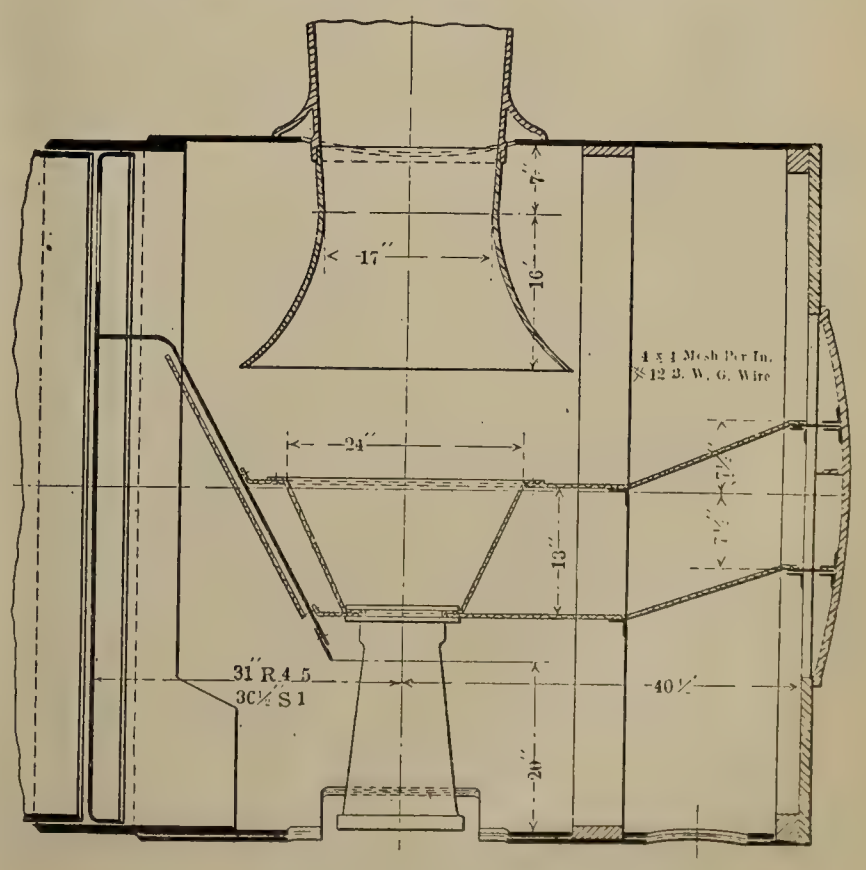


Fig. 3.

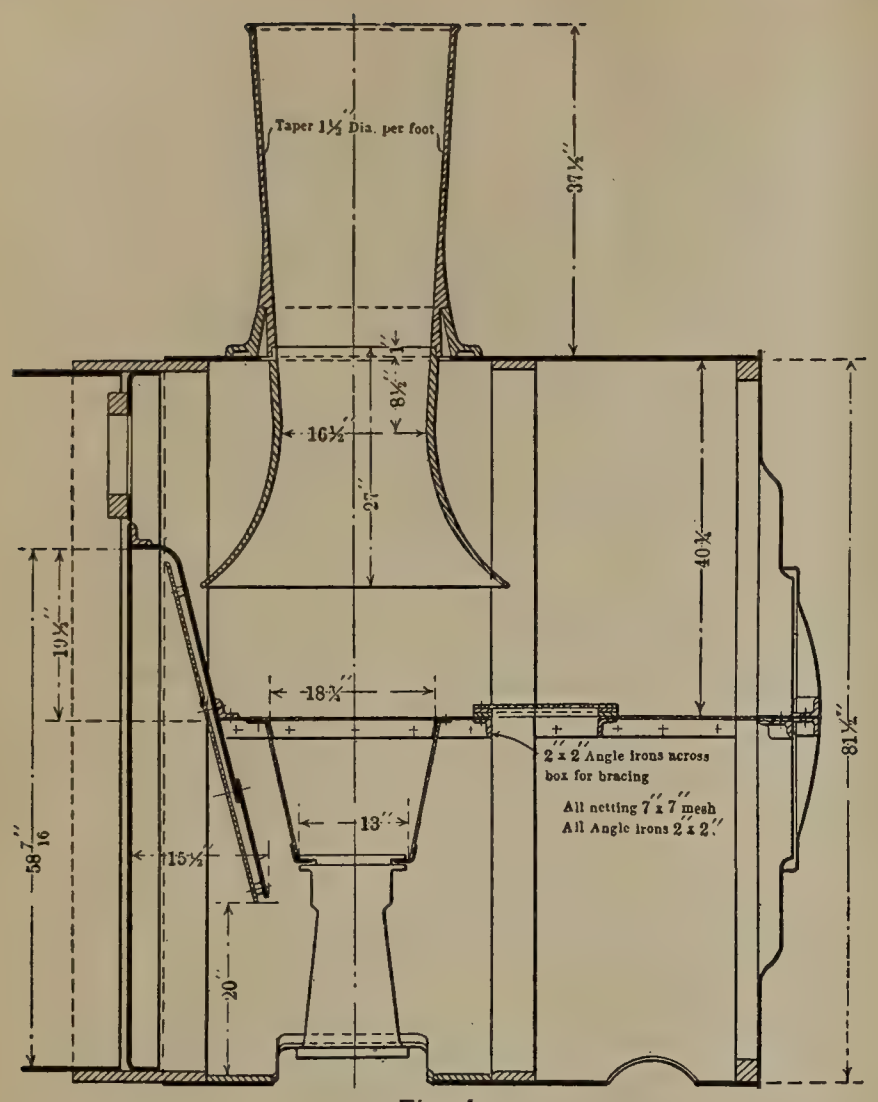


Fig. 4.

burned in a given time in order to develop the required horsepower. For this reason the great area must be greater—one authority says 50% greater—than would be required for good bituminous coal. The disintegrating action of the heat further complicates matters by increasing the resistance of the fuel bed to the flow of air through it. High drafts are necessary in order to overcome this resistance and maintain the required rates of combustion, and to get them the exhaust pressures must be increased to such an extent that the efficiency of the locomotive is reduced five to ten per cent thereby.

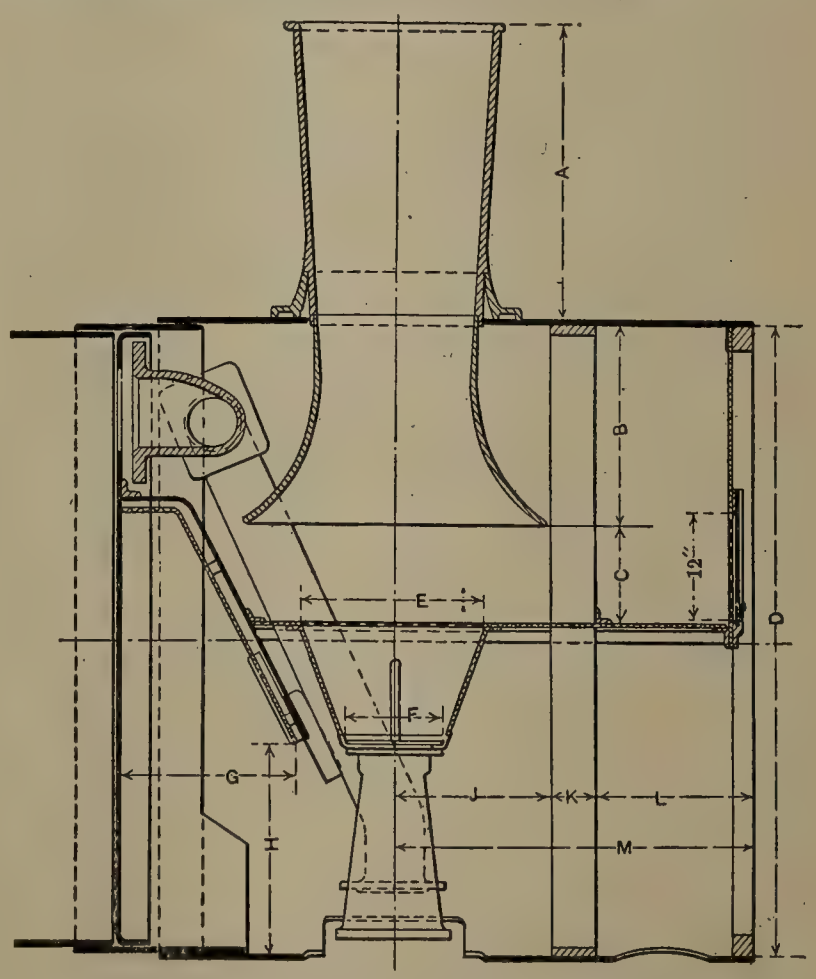
One point in favor of these sub-bituminous coals that should not be overlooked is the freedom from clinker troubles. The percentage of earthy matter in them is usually low—in many instances under five per cent—and the sulphur content is also low. If the refuse has any clinkering tendency at all, the clinker is of such a nature that it is easily broken up and therefore introduces no serious operating difficulties.

In some sections the greatest problem connected with the use of sub-bituminous fuels has been the one of preventing spark troubles. Because of the high drafts necessary for burning these coals and on account of the absence of any coking properties of the fuels, large quantities of sparks are carried out of the firebox. These sparks must either be caught by some arrangement of screens, or so delayed in passing out that they are cooled down to a temperature at which they will do not harm, or they must be broken up into particles of such small size that they will be dead before reaching the ground. The first attempts to solve this problem were made with different sizes and arrangements of screens and usually included two screens for the gases to pass through. Examples of such front-end arrangements are shown in Figs. 1, 2 and 3. It was usually found, however, that one of the screens clogged and prevented the free steaming of the engine. By using a single screen properly set most of the clogging trouble can be done away with, unless there is a steam leak in the smoke-box or wet slack coal is being used, and some roads claim to have found the screen as satisfactory and effective as any means for eliminating spark troubles. Screens set horizontally will, with some forms of stacks, remain clear longer and give less trouble than if set on an incline, and likewise small mesh netting of small wire is more satisfactory than small mesh netting made of large wire.

In using these small mesh screens in locomotives burning sub-bituminous coals it is very important that no holes be left around the edges of the screen or where it comes in contact with steam pipes, as any holes of this sort will give serious trouble. The front ends should be so arranged that they may be readily inspected and cleaned, and it is of the greatest importance that inspections be frequently and thoroughly made. Figures 4 and 5 show single-screen arrangements that have given good results.

A front-end arrangement designed to reduce in size the sparks or cinders, and also delay their delivery from the stack, is shown in Fig. 6, patents on which are held by the American Locomotive Company. On the western lines of one road a number of locomotives have been equipped with this device, and it is stated that the sparks are reduced to such small size that they give no trouble. Some of the engines so equipped have been in service as long as four years and others for over two years, and during this time no fires have been set out by sparks from them, although they are operated on the most dangerous divisions of the line. The sparks upon leaving the front end of the flues strike the baffle plate (d) and are deflected downwards. In front of the baffle plate is a table plate with an adjustable end (a), under which the sparks and gases pass. Deflector plates attached to the boiler front and to the top and bottom of the smoke arch, and a flat plate attached to the front end door again deflect the gases and solid particles, after which they pass through a 4x4 mesh netting (c), which surrounds the gyrus vanes (b). These vanes are separate castings attached to the bottom end of a bell-shaped casting suspended from the base of the stack and set with about a two-inch opening between them. In passing between these vanes the particles are further pulverized and by the time they leave the stack are harmless.

Another front-end arrangement for sub-bituminous coal burners is shown in Fig. 7. This device was designed by one of the road engineers of a western road and has been used principally in locomotives burning coal from the Roundup, Montana, dis-



Class	A	B	C	D	E	F	G	H	J	K	L	M
R-4, R-5, S-1	45½"	28"	11"	72"	19"	13"	20"	24"	17½"	5"	18"	40¼"
D-4-A, D-4-B	37½"	26"	12½"	81½"	20"	13"	15½"	20"	15½"	5"	22 1/16"	45 9/16"

Use 4½" x 4½" Mesh #12 B.W.G. Wire on Diaphagm Plate
" 7" x 7" " #16 " " " " in Basket & rest of Smoke Box

Fig. 5.

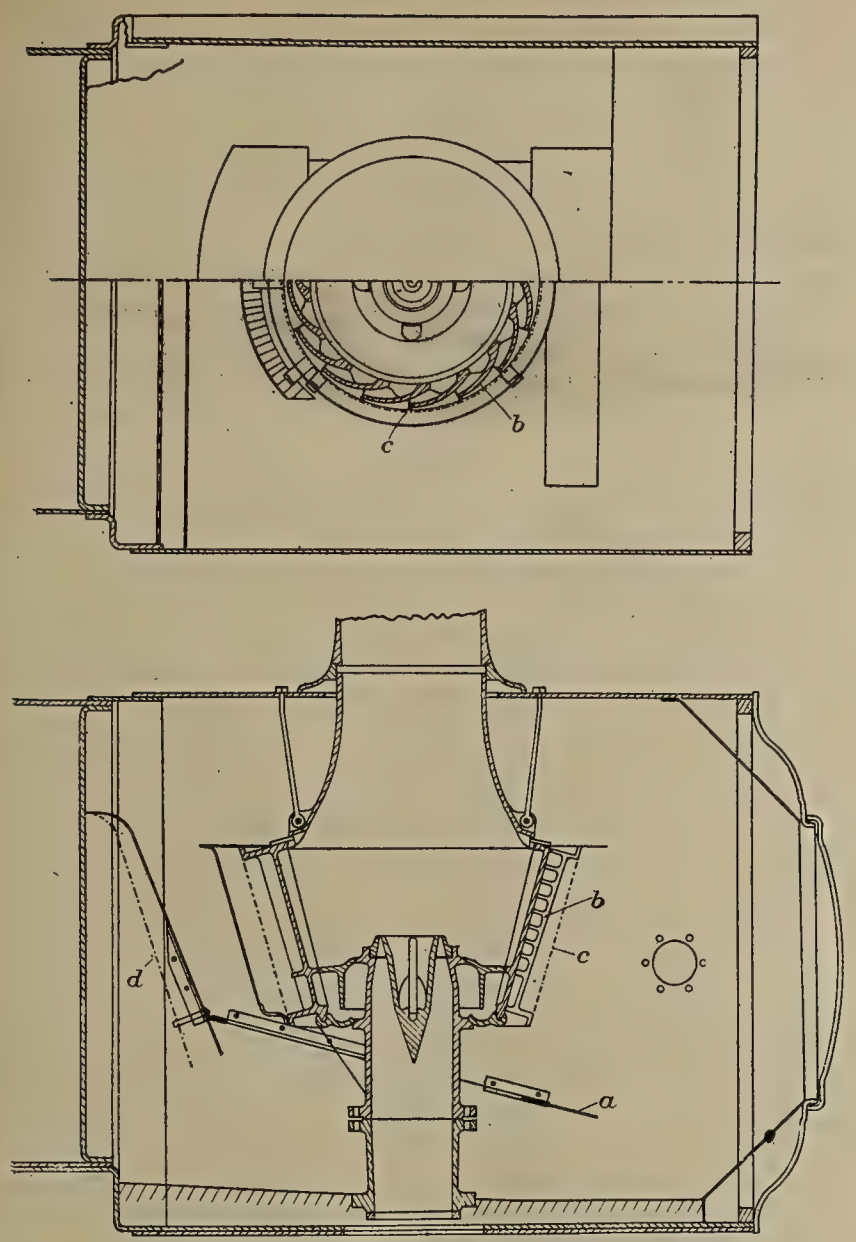


Fig. 6.

trict. With this arrangement the sparks do not pass through any screens or netting, the success of the device depending rather upon the delayed delivery of the solid particles, thus allowing them time to cool down. A roughened plate of ¼" steel is attached to the regular baffle plate at the front flue sheet and this, together with the table plate, fastened to a flange on the upper end of the exhaust pipe, deflects the sparks and gases, causing them to pass to the front of the smoke-box. A liner plate attached to the front-end door serves as another deflecting plate. From this point the paths of the sparks and gases are indicated by the direction lines and arrows. The top and bottom sides of the plate midway between the two petticoat pipes are faced with 4x4 mesh No. 8 netting shaped as shown in the cut. Sparks in passing between the housing surrounding the petticoat pipes and entering the latter strike these screens and are broken up into smaller particles before being discharged out of the stack. It is stated that this device will absolutely control the giving off of sparks, floaters or fires of any description.

In the following table are given some of the principal data and results of road tests made by different railroads to determine the value of the lower grade fuels. For purposes of comparison it would have been better had it been possible to obtain in each case figures for bituminous coal corresponding to those for the lower grade fuels. Because of the differences in conditions under which the tests were run the records as to coal consumption per 100 ton-miles, or for any other similar unit, would be of little value. The variation in the equivalent evaporation per pound of coal as fired shows probably better than anything else the relative values of the coals for locomotive service. For the last three tests these figures could not be inserted, as it was impossible to compute them from the data at hand. The coals from Las Animas, Colorado, and from Buxton, Iowa, are bituminous coals; the others are classed as sub-bituminous, although most of them are probably referred to more or less frequently as lignites. So far as the writer knows none of these coals in question have the very high moisture content or the other identifying lignite characteristics such as those of the Williston, N. Dak., fuel, analysis of which is given in the table on page 2.

The costs of using bituminous and sub-bituminous coals given below were determined for one road whose sources of supply for the two kinds of fuel were Buxton, Iowa, and Hudson, Wyoming, respectively. Cody, Nebraska, was considered as the approximate dividing point for the use of the two fuels and costs were figured to and from that point, using the results of a dynamometer car test as the basis of computations.

Bituminous Coal.

Price at Buxton, Ia.	$133.83
Cost of haul to Cody, Neb.	196.26
Cost to return empties.	54.63
Total cost	$384.72

Sub-Bituminous Coal.

Price at Hudson, Wyo.	$153.26
Cost of haul to Cody, Neb.	171.46
Cost to return empties.	47.88
Total cost	$372.60

Saving in favor of Wyoming coal, $12.12.

The results of these tests show that the better of these low-grade fuels can be used, and, in fact, they are today being used over those divisions of the roads where length of haul of bituminous coal makes it too expensive or otherwise inadvisable to use the latter fuel. The use of oil, however, has so many advantages that it will usually displace any solid fuel whenever the cost of oil is low enough to keep the fuel item in operating expense near to what it would be with coal used on the road. This substitution of oil for coal has to a considerable extent taken place in the Wyoming territory since the development of the oil fields in that state.

As to the future use of these coals, there seems to be no question but that they will be used in increasing quantities. There is doubtless much to learn yet relative to the proper grate area to heating surface ratios that will give best results with different coals. Some of the lines which are today using this sub-

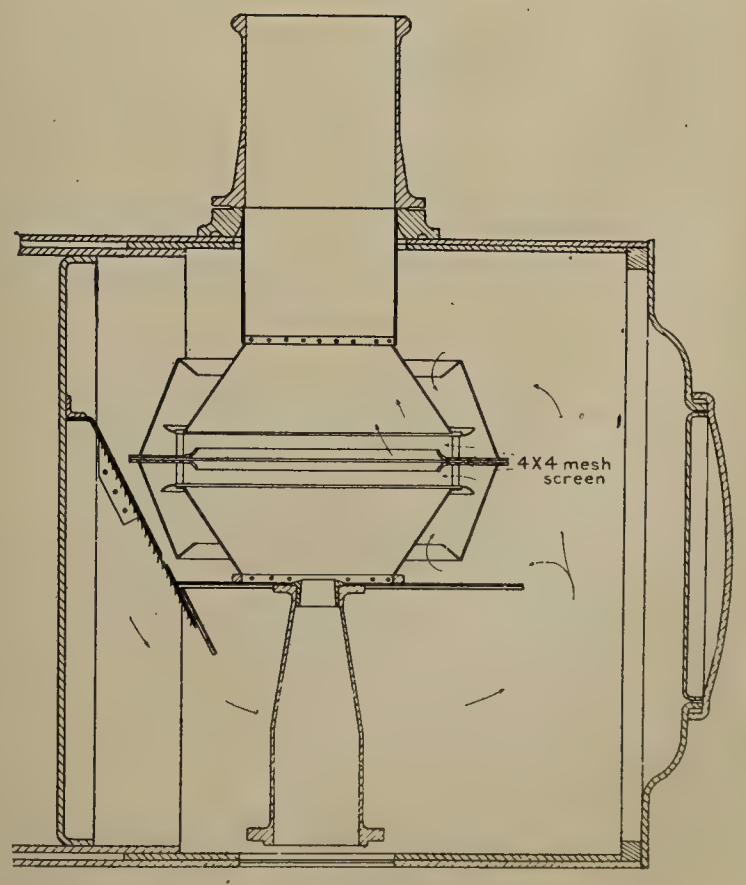


Fig. 7.

Gross Ton-Miles.	Number of Cars in Train.	Train Weight, Tons.	Average Steam Pressure.	Coal Used, Pounds.	Water Used, Gallons.	Equiv. Evap. f and a 212° F., per Lb. of Coal Fired.	Average Speed-Miles per Hour.	Service.	REMARKS.
86594	11.67	632.0	195.9	24916	14724	5.95	29.65	Passenger	Hannah, Wyo., Sub-Bit., C. & N. W. Ry.
88291	11.33	633.3	192.0	33120	14304	4.34	28.30	"	Erie, Colo., " "
213149	51.66	1888.9	177.1	42360	27255	6.47	17.15	Freight	Hannah, Wyo., " "
209541	55.33	1853.0	176.2	57311	28435	4.99	14.30	"	Erie, Colo., " "
.....	7.2	.....	201.0	17960	10265	5.86	32.90	.....	LaFayette, Colo., " C. B. & Q. R. R.
.....	7.5	.....	203.0	11650	10030	8.76	33.20	.....	Las Animas, Colo., Bit., "
161117	34.0	1445.0	194.0	17749	11900	6.83	.....	.....	Roundup, Mont., Sub-Bit., C. M. & St. P. Ry.
145011	.....	.....	.....	34034	19575	.....	23.1	Freight	Hudson, Wyo., " C. & N. W. Ry.
113387	21.5	588.9	.....	38726	21841	.....	21.9	"	Hudson, Wyo., " "
136387	.....	.....	.....	20845	13428	.....	23.8	"	Buxton, Iowa, Bit., "

bituminous fuel are using it on the same engines that at other times burn bituminous coal. It is possible that it may sometimes be found of sufficient advantage to build all the locomotives which are to be fired with the lower grade fuels with special reference to obtaining the best results from them.

Another factor, and an important one, in determining the extent of the future use of the low-grade coals is the rapidity with which the country, and especially these parts in which are deposits of these coals, develops. In many districts where sub-bituminous coals are mined there is little or no market for slack, but this finer size coal must be screened out of the mine run fuel in order to prepare it for the existing markets. With the growth of local industries will come more of a demand for the slack, which will, in turn, decrease the cost of locomotive coal at the mine. This will, of course, widen the area within which it will be uneconomical to use bituminous coal.

The probability of a marked increase in the use of the true lignites in the near future is believed to be not great. The present undeveloped condition of the parts of the country in which the lignites are found, their low heating value, and the availability of the better sub-bituminous coals are all factors that will check the increased use of lignitic coals for steaming, and particularly for locomotive purposes.

In closing, the author wishes to acknowledge his indebtedness to Messrs. S. C. Graham, Jas. H. Grove and O. N. Terry, who have served with the author on the committee appointed to prepare this paper and have furnished much of the information upon which it is based. Acknowledgment is also due to Messrs. C. G. Hall, J. G. Crawford and Eugene McAuliffe of this association for valued assistance in collecting material for presentation. Credit should also be given to Messrs. R. Quayle and A. E. Manchester, superintendents of motive power of the C. & N. W. and C., M. & St. P., respectively, for data relative to the use of the sub-bituminous coals on their lines. For further discussion of some of the problems of operation and additional details of the comparative tests of Wyoming and Iowa coals on the C. & N. W. Railway, those who are interested may refer to the *American Engineer and Railroad Journal* for May, 1908 (Burning Lignite Coal in Locomotives, by O. N. Terry), and to an article in the February, 1913, issue of the *Railway Master Mechanic* entitled, "Fuel Tests, Chicago & North Western Railway."

RAILWAY CLUB OUTING.

The members of the Railway Club of Pittsburgh, their ladies and friends, numbering about 500 were given a day of outing and entertainment by the Westinghouse Air Brake Co. at Wilmerding, Pa., on Friday, September 26, 1913. A special train left the Pennsylvania station, Pittsburgh, at 2:45 p. m. for Wilmerding, and upon arrival at that point the party were conducted through the works of the company by competent guides, after which a luncheon was served at 6 o'clock, followed by an entertainment in the auditorium. The party returned to Pittsburgh about 10 p. m. This outing took place on the day of the regular September meeting of the club and some business of the club was also transacted during the evening. A number of applications for membership were received.

THE GRAND TRUNK is to put into effect a safety organization and has engaged George Bradshaw, safety engineer, to perfect such an organization. Mr. Bradshaw will inspect the lines and shops and will deliver lectures at all important points on safety. A report will be presented later embodying recommendations for a safety organization.

TWO ALL-STEEL business cars to be used by officials of the Pennsylvania Railroad to transact railroad business while traveling will soon be finished at the Altoona shops.

STATISTICS COVERING the period from 1890 to 1912 on railways of the United States show that trespassers formed 53.8% of those killed, while the percentage of passengers killed in train accidents formed but 1.7%.

THE CHICAGO & NORTHWESTERN during the fiscal year ending June 30, 1913, carried 36,942,397 passengers, an increase of 1,151,954 over the number carried the year previous.

THE ADMINISTRATION of B. F. Bush as president of the Missouri Pacific-Iron Mountain system has resulted in a transition from a deficit last year of about $2,000,000 to a net income credit of $1,562,734.

Freight Car Troubles*

By J. C. Fritts, M. C. B., D., L. & W. R. R.

Up to fifteen or sixteen years ago it was the general practice to build cars with short draft timbers extending from the end sill back to and butting against the body bolster. These draft timbers were secured to draft sills, 5 x 8 inches and in some cases 5 x 9 inches, with four vertical bolts. I know of some cases where this practice was in use within the last three years. As a protection to the car against shocks it was the practice to use one or two helical springs between the followers for a draft gear. Cars having draft arms and attachments of this type will not stand the strains they are subjected to in the present long trains.

One of the first things I would suggest doing to relieve the present unsatisfactory condition would be to substitute, as soon as possible for the present short draft arm, one of metal construction that will extend back of the bolster. This would lead to an inspection of such cars by their owners to determine whether any of them would warrant the expenditure necessary to reinforce them with suitable metal draft arms and the application of a draft gear which would be a non-recoil, shock absorbing device. Cars which would not warant such repairs or renewals should be confined to local service where the owner would be the only one to suffer the consequences of perpetuating such equipment or they should be destroyed, using the money received from the sale of scrap to apply on the purchase of new equipment. I believe if we were able to keep a record of the amount expended on each car to keep it in service we could easily prove that so much of the total amount used was being spent on a certain lot or class of cars that it would be economical to take them out of service.

The Master Car Builders' Association, at its June meeting this year, discussed at some length the question of withdrawing from interchange service all cars of 40,000 or 50,000 pounds capacity. The discussion resulted in the following motion by D. F. Crawford:

"I would move that a committee of this association obtain from each of the members the situation as to each of their cars and ascertain if it would not be possible to make recommendation to the American Railway Association which will permit that for the benefit of the traffic conditions of the country we may set aside the older cars which are giving every one of us trouble that are moving them." This motion was seconded by M. K. Barnum, voted on and carried. This is a move in the right direction for instant relief and it behooves us to get in touch with the committee as soon as it is appointed and render all the assistance in our power. I believe, however, the question is one of draft timbers, draft gear and buffing arrangement more than capacity, or even age. However, should we eliminate the old cars, we still have a large number left that are giving a great deal of trouble in the way of broken draft sills, draft timbers, end sills, couplers, etc., and with such cars it is often hard for the mechanical man to decide the most economical method to follow.

Careful investigation indicates that the stresses due to buffing and pulling have more than doubled in the past ten years so that cars built to meet conditions of ten or twelve years ago are not able to stand present day service without serious damage resulting to themselves as well as adjacent equipment. It can hardly be expected that the cost of maintenance due to failures will remain constant with the same equipment under such varying conditions of operation.

One of the very common failures in the older equipment is draft timber bolts have been pulled completely through center sills. The latter are usually of sound material and properly applied, but the car simply has been subjected to greater stresses than it is possible for it to withstand. Due to the age and construction of this type of car the expense of applying proper reinforcements would not be justified, and if the cost to maintain the older equipment were kept separate from the newer and stronger cars it could be easily shown, as suggested above, that the proper course to pursue would be to destroy them and apply the scrap credit to new cars. There are, however, a large number of cars built at a later date that are subject to frequent failures, partly due, it would seem, to faulty construction. Many of the buffing parts have been constructed more from a theoretical standpoint than a practical one.

The draft arms that extend only from the end sill to the body bolster should not be used in any case. They are the cause of numerous failures together with resultant interruptions of traffic and should be replaced either by the continuous steel construction or long metal arms in connection with open bolsters, locking them with both the top and bottom members. As before mentioned, the general condition and age of the cars have to be taken into consideration when deciding which method of reconstruction should be used. This is the real problem for mechanical men to work out.

It is quite common to still see cars built having a center sill construction without cover plates, using diagonal braces from the outer ends of the body bolsters, needle beams and end sills to the center sills to avoid spreading or buckling. It has been demonstrated that this type of construction will not give satisfaction. It is thought by some car designers that if steel members are tied together at a distance in proportion to the width of the flange, it is sufficient and will meet all requirements. This practice may be mathematically correct but it does not prove out in service.

With center sills properly tied and strengthened between the bolsters, one of the most vital points is often overlooked; i. e., the draft arm, made of pressed steel shapes, is riveted to the center sills which have no cover plate, or other means of tying them together, resulting in frequent serious damage and delays to both equipment and lading. The experience of the writer indicates that riveting the draft arms to the center sills to facilitate repairs does not make as strong a construction as continuous sills. It forces a weak construction to start with, because, in order to make such a connection secure against buffing shocks and pulling stresses, a large number of rivets must be used in making the connection, and the holes for the rivets are sure to weaken the structure; but in either case cover plates should be used. The top one should extend from end sill to end sill and the bottom one as far through the bolsters as possible without interfering with the movement of couplers or draft gears.

The part of the car designed to withstand the buffing and pulling stresses is giving more trouble than all the other parts taken together and for this reason must be strengthened. There are two methods used in reinforcing old equipment.

First, for the older types of cars that we do not feel justified in going to the expense of providing with steel underframes, some roads are using a metal draft arm instead of the old oak timbers. These metal arms are being made of steel castings or standard rolled steel shapes riveted together in such a manner as to prevent the sills from spreading. I have tried both kinds and favor the steel casting for the reason that it withstands greater buffing stresses and can be moulded into one piece for each arm, making fewer parts for repair men to handle; the only extra parts needed are two or three tie plates riveted from arm to arm so as to make them both act together

* Extracts from a copyrighted paper presented before the Central Railway Club, Buffalo, N. Y.

in receiving the shocks. Furthermore, the metal can be moulded in any shape, which allows of a distribution to give maximum strength. These arms, starting at the striking plate should pass back, through and over the transom for a distance of at least 24 inches, and have square butting ends to receive a good stiff compression timber secured to under side of center sill. The compression timbers should be placed in line between the needle beams and from each needle beam to the butting face of the metal draft arm. They should also be fitted so tightly that a jack is required to get them in place, and they should be of a good stiff section, at least 5 x 6 inches. This type of reinforcing, including a modern friction gear, can be applied to a car for approximately $135 and I feel sure it is all that is necessary for a very large number of the old cars that are now giving trouble.

The other method is to apply steel underframes complete at a cost of perhaps three times that of steel arms. This is pretty expensive but there are a large number of cars that will warrant this expenditure. Some of these underframes have been giving considerable trouble; therefore, we should look carefully into these troubles and design future frames with a view to overcoming them.

In one of the latest types of steel underframe construction which it is believed has the greatest strength for a given weight, the center sills are continuous and the cover plates extend through the body bolsters as far as the construction will permit. Auxiliary cover plates at the center have been provided, both top and bottom. Securely riveted to the center sills is a top plate 20 inches wide, which will throw a great deal of strength into the center column over the center plate, where the failures show we have the most work to do, and also acts as a gusset, strengthening the frame against lateral forces. The back lugs have been extended to the bolster and act as stiffeners for the sills. The area of the cross section at the bolster is between 24 and 25 square inches, which we believe should be the minimum for a thirty-ton car. The center line of the coupler has been placed one inch below the neutral axis of the center members, this being a feature which does not seem to have been given proper consideration in the past. By keeping the force thrown against the car near the center of the draft sills, not only the liability of buckling but the breaking down at the bolsters is reduced to a minimum. Car designers should arrange the trucks and underframes so that this can be accomplished.

Experience from service conditions indicates very strongly that a modern friction gear gives the greatest protection, thus reducing the cost of maintenance and all other expenses incident to car failure. A very careful check of cars placed on shop tracks for repairs, in several parts of the country, shows that an average of 71% are so placed on account of defects that have developed due to shocks, and of a lot of 1,000 cars recently transferred it was found that over 80 per cent of the failures were also due to shocks. Investigation of the cause of damage to lading indicates that a large percentage can be traced to the same cause. If shock is responsible for so great an expense to the railroads in general, and we all know it is, what should be done to relieve the equipment of its ravages. We have already considered the underframe construction but the desired results will never be obtained unless some device, between the frame and the coupler, is installed which is especially designed to destroy or absorb the force of the blow. A car may be properly constructed throughout, but if it is not protected against the force of shocks which freight cars are subjected to, the weakest point will finally begin to fail. Strengthen this one and the next weakest will start to give trouble, and so on during the entire life of the car. Springs varying from 18,000 to 60,000 pounds capacity have been tried and gave good protection some years ago when cars were of light capacity and handled in short trains, but they do not meet the requirements of today. A large number of railroads, realizing this, have started to replace the spring gear with friction devices that have from three to four times the shock absorbing capacity that is practicable to obtain from a spring gear. In a device of this kind there should be no recoil. The force exerted by the recoil of a spring is practically as great as the force to compress it and results in much damage to equipment, especially in long trains.

The following statement gives the actual comparative service performance of these two types of gears, covering a period of twenty-six weeks, and shows very clearly the superiority of the friction gear:

	Broken Couplers	Broken Knuckles	Broken Knuckle	Broken Pocket Rivets	Broken Pockets
Various Types of Spring Gears...	1,526	710	2,421	3,143	207
Various Types of Friction Gears..	168	93	438	86	12

The information was compiled from weekly reports submitted by inspectors and shop foremen at every point on the entire system where repairs were made and is impartial and correct. The statement is self-explanatory and needs little comment. The majority of the spring gears were applied to wooden cars, which, to a certain extent, form a cushion themselves and greatly protect the parts susceptible to failures. In order to obtain a correct comparison, only defects that are common to both wooden and steel cars were considered, otherwise the results would be much more favorable to the friction gear. It is interesting to note that on 4,805 cars equipped with the friction gears there were 828 failures, or 17 per cent of the total number of cars, while of the 15,000 cars equipped with spring gears 12,211 or 81 per cent failed, a difference of 64 per cent in favor of the friction device. A reduction of car failures of this magnitude means a great saving to the railroads in general because of the increased earning power of the cars and the decreased cost of maintenance, lost and damaged lading accounts, delays and interruptions of traffic, transfers of lading and switching through the various terminals. The sum total cannot be estimated, but that it represents an enormous figure I believe we will all agree. It will also be noted that for every coupler broken there was 1.7 knuckle pins which failed, showing that this is the weakest point in the car coupler. We know that the manufacturer as well as the M. C. B. committee on coupler designs is considering this point and arranging to relieve the knuckle pin of a large part of the work the present design of coupler throws upon it.

I fear that some users do not appreciate what a draft gear is called upon to do. I am free to confess that up to the time I started to investigate this question some years ago, I did not credit it with being such an important factor in the question of car maintenance, and other expenses incident to car failures. It is the only device that we apply to a car to protect it and its lading from damage. It has no other function to perform. It must destroy shocks from impact, shocks from pulling and shocks due to recoil. I will try and point out a few of the damages occurring to cars because of the draft gear failing to perform the work for which it is intended.

If it were possible to put a draft gear between the coupler and the car that would absorb the heaviest shock, we would eliminate broken couplers, and their removal would not be necessary until they are worn out, and I believe the coupler bodies of late design are sufficiently strong to last approximately the life of a car.

While knuckles wear out in service there are a great many of them that break from shocks, and here again the draft gear that will relieve the coupler from shock also relieves the knuckles.

With coupler yokes the failures are due to shocks and I think they are being replaced by other forms of attachments, on account of pocket rivet failures which are due to the rivets being in shear under impact. In several years' investigation of the draft gear question I have satisfied myself that by eliminating this feature, the wrought iron, or forged steel

yoke, with 1¼ x 5-inch section riveted to the coupler with two 1¼-inch rivets can be operated with very few failures.

I think no one here will deny that draft springs are destroyed by shock, and with a properly designed friction draft gear I have learned that this failure can be reduced to a very low figure, for the reason that the draft springs are not driven solid even though the draft gear receives a shock sufficient to close it.

The end of a car is often burst by the lading it contains or the lading from an adjacent car. In either case it is on account of the lading moving in an effort to perform the work that the draft gear should have done. However, I believe that more attention should be given to reinforcing this part of the car. Side doors raked and knocked off, laying along the track, or hanging by one hinge, is a damage caused by shock.

Everyone knows of the trouble we are having with car roofs and I think you will agree that it would be very little trouble to apply a satisfactory roof if the car were standing still all of the time, but the roof being located so far above the floor line and the coupler below the floor line, with a more or less weak construction between the roof and the floor, it cannot help but be racked to its final destruction by the shocks delivered to the car through the coupler. It has been stated that a poor roof will last longer on a car equipped with an efficient draft gear than a good roof on a car with a poor draft gear. The writer is not in a position to either contradict or confirm this statement but I do know that by replacing an inferior gear with an efficient one is equal to strengthening every part of a car that is susceptible to failure from shocks.

In closing, I have to offer as a relief to the present situation:

First—Reinforcing the older types of cars that will not stand the expense of a steel underframe, with a long metal draft arm that extends through and over the body bolster. This in turn to be reinforced or backed up with good, heavy compression timbers.

Second—On such cars as will permit of the expenditure, the application of a carefully designed steel underframe.

Third—In all cases apply the draft gear that will destroy the greatest amount of shock with the entire elimination of recoil.

Fourth—The adoption of a standard specification for the testing of draft gear to determine its shock absorbing capacity, and amount of recoil, before purchasing.

Fifth—Substitute for the present wooden roof an all metal one as soon as it has been demonstrated what the proper construction should be.

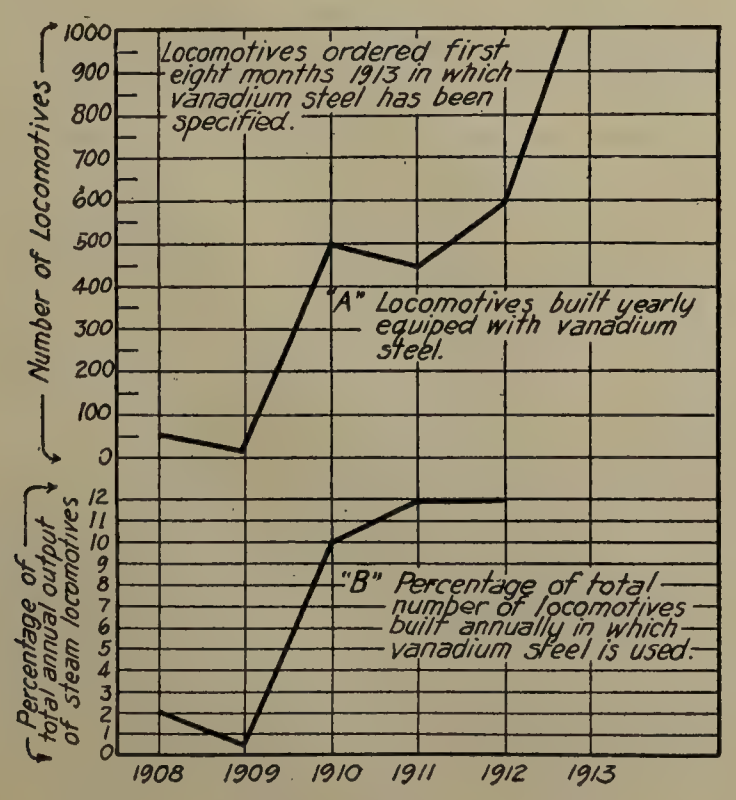


Chart Showing Growth of Application of Vanadium Steel in Locomotive Construction.

VANADIUM STEEL AND ITS APPLICATION IN LOCOMOTIVE CONSTRUCTION.*

By Geo. L. Norris, American Vanadium Co.

The last ten years have witnessed great and abrupt increases in size, weight and power of locomotives. The enormous and rapidly increasing freight tonnage can only be handled adequately and economically by means of the monster locomotives that have become so common during the past five years.

That the present heavy power represents the limit is hardly to be supposed. Already the limits of carbon steel have been practically reached for many parts, and it is necessary to turn to alloy steels to obtain the necessary strength and endurance required for the economical maintenance of these locomotives.

In a recent address on "Motive Power Utility," H. D. Ballentine, assistant to the second vice-president of the Chicago, Rock Island & Pacific, gave the rather startling life history of the average engine. Out of the 24 hours the locomotive spends 12 hours and 45 minutes in the hands of the mechanical department, of which 4 hours and 8 minutes are for classified repairs and 2 hours and 37 minutes for running repairs, the remaining 6 hours being in the roundhouse. Adding to the time in the mechanical department the terminal and operating detentions he finds that the average engine is in actual revenue operation 4 hours and 19 minutes out of the 24 hours. The earning power of a large engine is given as $1 a minute while actually moving tonnage.

The greater cost and earning power of these monster locomotives makes it more necessary than ever to keep them in service, and the additional first cost of alloy steels over simple carbon steel is more than offset by the reduction in maintenance costs through the elimination of failures and greater length of service or mileage, per unit of wear, and also by the lengthening of the earning periods between shoppings.

While an increase in the physical properties of simple carbon steel can be obtained by heat-treatment, only a relatively small increase can be so obtained without danger of producing brittleness. Carbon steel such as is used for locomotive forgings is not especially well suited for heat-treatment.

Of the various alloy steels, the vanadium steels are the most suitable and have come into most general use. They respond to heat treatment perfectly, have a high elastic limit, or useful strength, in proportion to ultimate strength, possess great toughness and dynamic strength and high wear-resisting qualities.

The growth and extent of the use of vanadium steels in locomotive construction is graphically shown in the curves of the accompanying chart.

Curve "A" shows the number of new locomotives equipped with vanadium steel parts, built in each year from 1908 up to and including 1912, and the number ordered during the first five months of this year with vanadium steel specified.

Curve "B" shows the percentage of all the locomotives built yearly in which vanadium steels have been used. Analysis of these curves brings out some interesting facts as to the extent to which vanadium steel has come to be applied to locomotive construction.

In 1908, when several of the leading railroads specified vanadium steel parts for test purposes, only fifty-three locomotives were so equipped, or 2 per cent of the total number built that year. Awaiting the outcome of these tests but little vanadium steel was specified on locomotives built during 1909, as shown by the downward trend of both curves. Evidence of the success of these tests is shown by the marked increase in the specification of vanadium steel for locomotives built in 1910, as shown by the abrupt rise in both curves. From 1910 the use of vanadium steel in locomotive construction has been steadily increasing.

The drop in curve "A" for the year 1911 is accounted for

* From a paper read before the Western Railway Club.

by a reduction of 25 per cent in locomotive construction as compared with 1910. This drop is offset, however, by the rise in curve "B" for the same period. Last year over 25 per cent of the locomotives built weighing over 200,000 pounds had vanadium steel parts.

While the metallic element, vanadium, was discovered about 100 years ago, its use in the manufacture of steel is only of recent date. Practically nothing was done towards using vanadium in steel until 1896, when a few test armor plates were made at Firminy, France. The tests on these plates showed very superior results, but there was no adequate supply of vanadium in sight to make its use commercial. Vanadium was known to be very widely disseminated in many rocks and minerals, but no large deposits of vanadium ore were known to exist. The principle source of supply was the Santa Marta lead mines, Spain, from whose ores considerable vanadinite, a lead vanadium mineral, was concentrated. The vanadium from this and other similar sources was used for a chemical purpose, principally in the manufacture of analine black.

Almost nothing seems to have been done in the way of using vanadium in steel after the tests of armor plate referred to until 1900, when Prof. Arnold, of Sheffield, England, made some investigations of the effect of vanadium on steel for an English concern who had started to produce vanadium alloys. The tests were made with simple carbon tool steels, and the addition of vanadium was found to raise the elastic limit from about 50 to 100 per cent without affecting the ductility of the steel. Drills made from some of this steel containing only 3-10 per cent of vanadium in competition with a 3 per cent tungsten tool steel proved to be 75 per cent better. Prof. Arnold's report states "The results of this preliminary investigation have profoundly impressed upon my mind the future before vanadium as a steel making element." Further tests and investigations were made by Prof. Arnold with small percentages of vanadium in conjunction with other alloys, tungsten, nickel and chromium. In each case an increase of about 50 per cent in elastic limit was obtained, the chrome steel with vanadium also showing very superior dynamic strength. Meanwhile, other investigators were busy and by 1905 about 800 tons of vanadium steels a year were being produced, principally air hardening and high speed tool steels, with some small tonnage of chrome-vanadium steel for automobile parts.

In this year an added impetus was given to the use of vanadium in the making of alloy steels, through the discovery in the Andes of Peru of an immense deposit of vanadium ore of a richness and character hitherto unknown. From a rare or semi-rare metal, vanadium became available as a steel making metal in unlimited quantities.

The metal vanadium is non-magnetic; has a very high electrical resistivity; melts at about 1,690° C., and is the most difficultly reduced and hardest of the metallic elements. On account of its great affinity for carbon, oxygen and nitrogen at high temperatures, absolutely poor vanadium has not been produced. Owing to its very high melting point, vanadium, even if it were commercially possible to produce it reasonably pure in the metallic state, would present much difficulty in alloying with other metals. Fortunately it is relatively easy to reduce vanadium as an alloy of iron, ferro-vanadium, containing approximately one part of vanadium and two parts of iron. This alloy has a melting point of about 1,300° to 1,340° C., which is low enough for it to melt and alloy readily when added to molten steel.

According to Prof. Arnold, vanadium is undoubtedly the element which together with carbon acts with the greatest intensity in the way of improving alloys of iron, that is to say, in small percentages. He was of the opinion that vanadium combined to form a double carbide of iron and vanadium and it seemed to have not only a chemical but a physical influence in promoting the even distribution of the carbon, and retarding constitutional segregation. In this matter it renders steel particularly susceptible to the highly important improvements due to heat treatment, and in addition is a powerful factor in the production of steels that are very resistant to wear, erosion and fatigue. This opinion of Prof. Arnold has been amply confirmed since it was made by the results in service of thousands of tons of vanadium steel. It is the most powerful metal yet discovered for alloying with steel. Its intensifying effect on the other elements in steel, carbon, silicon, manganese, chromium, nickel, etc., is so great that, although these elements are usually present in greater amounts, the steel is improved and changed to such a degree by the vanadium that it is properly designated as vanadium steel, chrome-vanadium.

Vanadium steels can be grouped into several classes:

1. Simple carbon vanadium tool steels.
2. High speed tool steels.
3. Simple vanadium steel for castings.
4. Vanadium alloy forging and machinery steels, such as chrome-vanadium, nickel-vanadium and nickel-chrome-vanadium.

I will only touch briefly on the first two classes, as my subject has to do more directly with the third and fourth classes of vanadium steel, which are directly used in locomotive construction.

Simple carbon vanadium tool steels are rapidly coming into very general use for all purposes for which carbon tool steels are used. They temper more uniformly to a greater depth than the same steel without vanadium, and in addition are very much tougher and stronger and hold a cutting edge much longer. A 1-inch diameter bar of spring tempered vanadium tool steel containing 1 per cent of carbon and 3/10 per cent vanadium can be bent through 90 degrees without failure, while a simple carbon tool steel of the same percentage of carbon and tempered in the same manner would only bend through an angle of 15 degrees before failure.

The wonderful effect of vanadium in strengthening tool steel is shown in the following compression tests made on 1¼-inch cubes hardened and tempered alike, and accounts in a measure for the great superiority of vanadium tool steel over regular carbon steel tools.

Grade	Carbon, per cent	Load 1st crack	Max. load	Max. Strength per sq. in.
Simple	1.30	268,900	268,900	172,307
Simple	0.90	278,500	317,500	203,525
Simple	0.80	365,440	440,650	282,307
Vanadium	1.10	479,000	481,700	308,788
Vanadium	0.90	490,000	506,500	324,692
Vanadium	0.80	498,000	505,100	323,782

Service reports of vanadium steel taps, dies, reamers, shear knives, punches, pneumatic tools, stamping and punching dies, show from three to twenty-five times more work than simple carbon steel.

In high speed tool steel the use of vanadium has become practically universal. The addition of vanadium has more than doubled the cutting speed and the time between grindings. The addition of vanadium also has made it possible to quench high speed tool steel successfully.

Taking up the vanadium steels that are used more directly in locomotive construction, we find that the earliest application was for cast steel locomotive frames. A number of vanadium steel frames were put into service early in 1907 and all of them are still in service without having failed. There are over 5,000 vanadium cast steel frames in service today and for heavy locomotives they are rapidly becoming standard. Failures of vanadium frames have been insignificant, less than ½ per cent from all causes. If we eliminate failures due to an especially weak point in design, from wrecks or failure of other parts, the percentage of failed vanadium frames is less than 1/10 per cent.

An investigation made a few years ago showed that frame failures constituted at least 20 per cent of the cost of locomotive maintenance. The use of vanadium steel frames, therefore, means a very substantial lowering in maintenance costs,

and increase in earnings. Consider the record of vanadium steel frames on three roads that are extensive users, having a total of 1,500 frames in service last May. These roads are the D., L. & W., the N. Y. C. & H. R. and the Southern Ry. The total failures from all causes were nine, and of these six occurred on the D., L. & W. on a group of eight ten-wheel passenger locomotives, and were due to an admittedly weak point in the design. A slight change in the design was made on the next lot of locomotives of this type and no further failures occurred. Since 1908 practically 80 per cent of the new locomotives on the D., L. & W. have been equipped with vanadium frames, and in addition many of the old engines have also been equipped.

The Southern Railway has probably had the most extensive experience with vanadium steel frames of any railroad, they having practically been standard since 1907. Their records show that in the six years there have been only three failures, two of which were caused by failure of other parts of the locomotives.

The experience of the N. Y. C. & H. R. railroad has been even more satisfactory, as no vanadium steel frames have failed. A pair of vanadium frames was applied to one of a lot of heavy Pacific type passenger locomotives built in 1908, the others being equipped with the regular carbon cast steel frames. Failures of the carbon steel frames began within two years and up to March of this year there had been thirty-five failures. As a result of the showing made by these and other vanadium steel test frames, the N. Y. C. & H. R. has made vanadium cast steel frames standard equipment for road locomotives.

The experience of the N. Y. C. & H. R. is typical of most of the roads using vanadium steel frames, that is in failures.

While the principal application of vanadium cast steel has been for locomotive frames, it is being used to advantage for other castings, as, in addition to its high elastic limit and dynamic strength, it has a much higher wear resisting quality than ordinary cast steel.

Vanadium steel castings differ in composition from ordinary steel castings only by the presence of .16 per cent to .25 per cent of vanadium. The addition of this amount of vanadium increases the elastic limit 30 to 40 per cent above that of the same steel without vanadium, in the annealed condition, and without decreasing the ductility as determined by elongation and reduction of area. In general the ductility is considerably increased as well. The dynamic strength, or resistance to repeated stresses, is very much increased, generally 50 per cent or more. Some idea of the toughness and shock resisting qualities of vanadium cast steel frames can be obtained from the accompanying illustration, figure 2, of a frame, a rocker casting and a crosshead arm bent cold by blows of a 3,000-pound drop ball. The number of blows for each casting and height of drop are as follows:

FRAME.	CROSSHEAD ARM.	ROCKER CASTING.
15 blows from 17 feet	3 blows from 3½ feet.	1 blow from 5½ feet
1 blow from 15 feet	2 blows from 3 feet.	3 blows from 12 feet
	1 blow from 5 feet	1 blow from 16 feet

The physical properties are as follows:

	Frame	Rocker Casting	Crosshead Arm
Elastic limit, lbs. per sq. in.	49,380	50,020	50,200
Tensile strength, lbs. per sq. in.	80,600	79,460	79,860
Elongation in 2 ins. (per cent)	27	27.5	28.0
Reduction of area, per cent	54.7	49.1	47.0

Carbon steel castings of the same composition made in the same foundry show an elastic limit of about 37,000 to 39,000 lbs. per sq. in.

In breaking up scrap frames it is found that the vanadium frames require several times as many blows of an 8,000-lb. drop ball to break as do the carbon frames. Eight or nine blows is not unusual for the vanadium frames, while carbon frames usually only require one or two blows to break.

The change effected in the micro-structure of casting steel by the addition of vanadium is as remarkable as its effect on the physical properties. There is a marked difference in both the unannealed and annealed structure. The interlocking character of the ferrite in the annealed steel accounts in a large measure for its great toughness and dynamic strength.

Coming to the fourth classification, vanadium alloy forging and machinery steels, we have in chrome-vanadium steel a steel that is now being extensively used and will no doubt become generally used for such locomotive parts as tires, rolled wheels, axles, connecting rods, crank pins, piston rods, springs, air brake pump tappet rods, valve motion, and various other parts subjected to repeated stresses and great wear. It responds perfectly to heat-treatment, giving a high elastic limit combined with hardness and great toughness and superior wear resisting qualities.

Tires and wheels are probably one of the largest, if not the largest, single item of maintenance cost of locomotives, and the cost is constantly growing with the rapidly decreasing mileage due to increased loads and harder service. From the time that the weldless steel tire was invented by Krupp, in 1853, the composition of the steel used has remained practically the same. With the marked increase of weight and power of locomotive equipment that has taken place during the last ten or twelve years, the tire mileage has rapidly decreased. It is evident that there is need of an improvement in the quality of the tires, not only to obtain better mileages under present conditions but to successfully meet the more severe conditions of the near future.

The only way to improve the quality of the steel now in general use is by heat-treatment of the tires. However, this steel is not especially suited to heat-treatment, and only relatively small increases in physical properties can be obtained by this means, without increasing the danger of the tire breaking through brittleness. It is apparent then that the improvement in tires which will bring increased mileage must come about through a change in the composition of the steel, as well as by heat treatment.

During the past year there has been made and put into service about 1,000 heat-treated chrome-vanadium tires to specifications calling for an elastic limit 75 to 100 per cent greater than obtained in ordinary carbon tires and about 50 per cent greater than for heat-treated carbon tires.

The specifications call for a falling weight test as well as tensile test. In making these falling weight tests the tires were dropped on from heights that would not be attempted in the case of carbon tires.

Steel tired tender and coach wheels and rolled steel wheels come in the same category as the locomotive driving tires so far as fast wear is concerned. In addition they are liable to give considerably less mileage per $\frac{1}{16}$ inch, due to danger of shelling or flaking on the tread, which necessitates considerable loss in metal to remove these defects.

The use of chrome-vanadium steel will doubtless reduce the liability to shell to a very great extent judging from the micro-structure and physical properties of the vanadium steel. This opinion is apparently confirmed by the records of tender wheels on two roads that have considerable trouble from shelly treads. None of these steel tired wheels have been reported as shelling.

For axles, side and main rods, crank pins, and piston rods, chrome-vanadium steel has proved its superiority both from the standpoint of freedom from failures and greatly increased mileage per unit of wear. There are several thousands of the forgings in service, and the failures have been a very minute fraction of a per cent. These parts are heat-treated to give an elastic limit of 80,000 to 100,000 pounds per square inch with an elongation in two ins. of not less than 20 per cent, and a reduction of area of not less than 50 per cent. Axle and side rods and piston rods with these physical properties have been bent through 180 degrees.

Careful comparative records of the wear of vanadium steel

driving axles and carbon steel axles are being kept by the test department of the L. S. & M. S. Ry. The latest report which I have shows a little over 2 to 1 in favor of the vanadium steel. Summarized, the record is as follows:

Vanadium steel axles—21 locomotives.

Average wear-diameter, inches	.0187
Average mileage	73,201
Average miles per 1/100 inch wear	39,145

Carbon steel axles—17 locomotives.

Average wear-diameter, inches	.0359
Average mileage	61,099
Average miles per 1/100 inch wear	17,019

On 20 heavy Mikados, recently ordered by the L. S. & M. S. Ry., the diameters of the front, intermediate and back axles were reduced to 9¾ inches between journals which were 11x12 inches. Compared with common practice for carbon axles of this size journals, this amounted to a reduction of ¾ inch diameter in the case of the front and intermediate axles and 1 inch in the case of the rear axle.

Piston rods and crank pins are making equally good showing in mileage per unit of wear in diameter.

The high wearing qualities of chrome-vanadium steel has led several railroads to specify it for valve motion parts with the object of doing away with the delays and annoyances of case-hardening.

Air pump tappet rods of vanadium steel are now standard on practically all of the compound pumps.

TYRONE COLLISION REPORT.

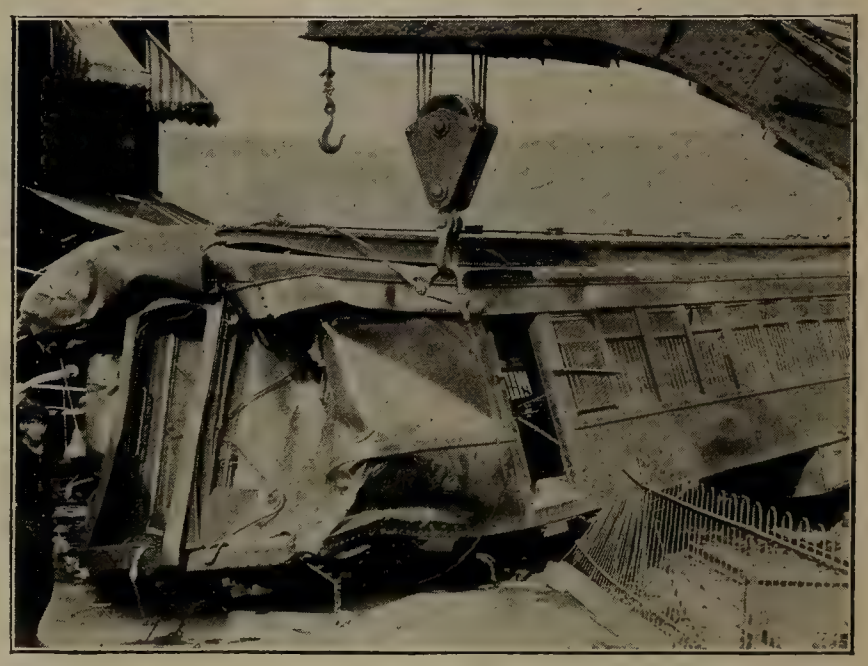
The Interstate Commerce Commission has issued the report of the chief inspector of safety appliances on the wreck which occurred on the Pennsylvania at Tyrone, Pa., on July 30th. This, it may be remembered, was a rear end collision between two passenger trains, No. 13 running into No. 15 while it was standing at the station. The cars in both trains were of steel and No. 13 was an eight car train running at about 30 miles per hour. Quite a number of passengers in No. 15 were injured, but the only fatality occurred on No. 13, the engineer being killed. The front mail car of No. 15 was overturned, while the locomotive and three cars of No. 13 left the rails.

The illustrations show very clearly the manner in which the steel cars withstood the shock. The parlor car, it will be noted, was partially crushed but with the others the crushing of the vestibules took up most of the shock.

Engine and Parlor Car.

Rear End of Diner and Front End of Parlor Car.

The report of the safety appliance inspector states that No. 13 had the distant and home signals set against it but ran by them. An assistant road foreman of engines was on the engine of No. 13 and when they came to the signals he called



First Car of Train 13, Which Was Thrown Against the Station.

them, instead of leaving it to the engineman and fireman. For this he was censured as was also the fireman. The rear brakeman of No. 15 had started back but had only gone 500 feet when he was called in. As he was still opposite the station platform he did not put down torpedoes.

RETURNS FOR JUNE, 1913, for the railways of the United States, reduced to a per mile of line basis and compared with the returns for June, 1912, show an increase in total operating revenues per mile of 5.9 per cent, and an increase in operating expenses per mile of 8.9 per cent. Net operating revenue per mile was less by $1.42, or 0.4 per cent, than that for June, 1912, while that for June, 1912, was 4.4 per cent greater than for June, 1911.

"There is no room for sadness when we see a cheery smile;
It always has the same good look—it's never out of style.
It nerves us on to try again when failure makes us blue;
The dimples of encouragement are good for me and you.
It pays a higher interest, for it is merely lent—
It's worth a million dollars, and doesn't cost a cent."

Cumberland Terminal, B. & O. R. R.

The terminal of the Baltimore & Ohio R. R. at Cumberland, Md., is situated at the foot of the eastern slope of the Allegheny mountains near the convergence of the lines from the west and is a terminus for the district lying west of Washington and Martinsburg. Both passenger and freight traffic through this point is extremely heavy. Practically all of the locomotives used in this territory are of the heavy Mallet and Mikado types in freight service and the heaviest type of Pacific in passenger service.

B. & O. Roundhouse at Cumberland, Md.

The old engine terminal had become entirely inadequate to properly take care of the heavy locomotives. This situation was rendered more acute by the extremely cold weather that prevails for relatively long periods. Sufficient ground space for the new terminal was available alongside of the old facilities. The improvements consisted of a roundhouse with a 100-foot turntable, a double cinder pit, a reinforced coaling station, a sand house and a small power house, all conveniently arranged and embodying an up-to-date locomotive terminal with buildings and other facilities of permanent construction.

In order to accommodate the large Mallet locomotives the length of the roundhouse was made 110 feet. There has been constructed at this time thirty-one stalls and space is left for further extension. A deck type turntable 100 feet long is used.

The building is constructed with brick walls on concrete foundations with timber roof posts and beams supporting a wooden roof. The rear wall of the house is made up of brick pilasters with broad window spaces between with top and bottom sash counterbalanced with each other.

The roof line is broken at the first row of posts near the front of the building so as to give a row of sash with narrow vertical louvre over each stall to provide light and ventilation.

The locomotive door openings are fitted with wooden rolling doors of improved type, which can be repaired at minimum cost when accidentally damaged.

On account of the types of engines handled consisting principally of Mallets, Mikados and large Pacifics, the engine pits are made 88 feet long with side pit walls for a distance of 40 feet on the inner end made of sufficient width to provide bearing for jacking. The pit walls are extended 12 feet outside of the house to prevent track settlement.

To facilitate handling repairs to Mallet engines, twin driving wheel drop pits, serving four stalls, are provided. In addition two stalls are provided with truck wheel drop pits. These pits are furnished with hydraulic pneumatic jacks of 30 tons and 15 tons capacities, respectively.

The floor wearing surface is one-half of creosoted wooden blocks 3 inches deep and one-half of mastic rock 1½ inches thick. Both types of floor are underlaid with 6 inches of concrete. The use of these two materials will give an effective test of their relative merits.

The building is heated by the indirect system, using one 200-inch fan and one 190-inch fan with capacity to completely change the air in the house about once in 15 minutes. One of

B. & O. Terminal at Cumberland, Md., Looking South.

Consolidation Locomotive for the Canadian Northern.

these fans also supplies the air for heating the adjoining machine shop. These fans are located in separate rooms built as small additions to the engine house.

The main air duct is of concrete encircling the house inside the outer wall with laterals of tile pipe leading to outlets alongside of the wooden columns supporting the roof, there being three outlets in each stall. In addition to the outlets provided in the body of the building there are also two hot air outlets provided under the windows in each panel of the back wall.

An exhaust main is run from the power house to the 190-inch fan so as to permit the use of such exhaust steam as may be available, but in the main heat is supplied by live steam. All piping for the boiler washing system and for the steam, water and air service is brought from the power house through a short tunnel, but distribution in the house is overhead.

Sixty-watt tungsten lamps are used for lighting, five being placed in each stall.

Closely adjacent to the engine house and connected to it by a covered passageway, carrying a track connecting to one of the stalls of the roundhouse, is a machine shop 70 feet by 140 feet. Machine tool equipment is installed for taking care of light running repairs including a driving wheel lathe.

The machine tools are driven by electric motors. The shop is heated and lighted in the same manner as the roundhouse.

At the west end of the shop in a separate room toilet facilities for the men are provided. At the east end of the machine shop and attached to it is a two-story office building about 33 by 64 feet. This is a brick building divided by lath and plaster partitions into rooms for the master mechanic, road foreman of engines, roundhouse foreman, storekeeper and their clerks, also the engine dispatchers' room with train board. This building is lighted by tungsten lamps and heated by direct steam heat.

The engine room equipment consists of one 1,000-foot air compressor, a large fire pump, three 50 kw. 2,200/440 volt transformers for power purposes, one 50 kw. and one 25 kw. series arc transformers for lighting purposes, and a six-panel switchboard. In the basement at one end of the engine room are located the boiler washing pumps.

The boiler room equipment consists of two batteries of water tube boilers aggregating 1,000 horsepower. The boilers are fitted with automatic stokers to which the coal is delivered by gravity from an overhead bunker. The coal is dumped into a hopper outside of the power house and is lifted with a bucket elevator onto a belt conveyor and discharged into the bunkers by means of an automatic tripper. Ashes are removed by hand.

The cinder pit is located between the coaling station and the engine house. This is a double pit of the submerged type, having an overhead traveling crane with a grab bucket. The cinder pit stands practically full of water at all times. Into this the cinders are dumped and loaded by means of the grab bucket into cars standing on a track between the two ash pits. About 120 engines are handled over this pit daily. The economy of loading the cinders may be judged by the fact that one man working during the daylight hours only is able to load all the cinders.

Cinder Pit, Crane and Runway at Cumberland.

The coaling station is located, as stated, in advance of the cinder pit. The structure is of reinforced concrete with bunker capacity for 600 tons of coal. The bunker is divided into four bins to handle three sizes of coal: Run-of-mine, coal crushed for locomotives equipped with stokers and special coal for passenger locomotives. As the greatest consumption is of run-of-mine, two of the bins are used for storing this size.

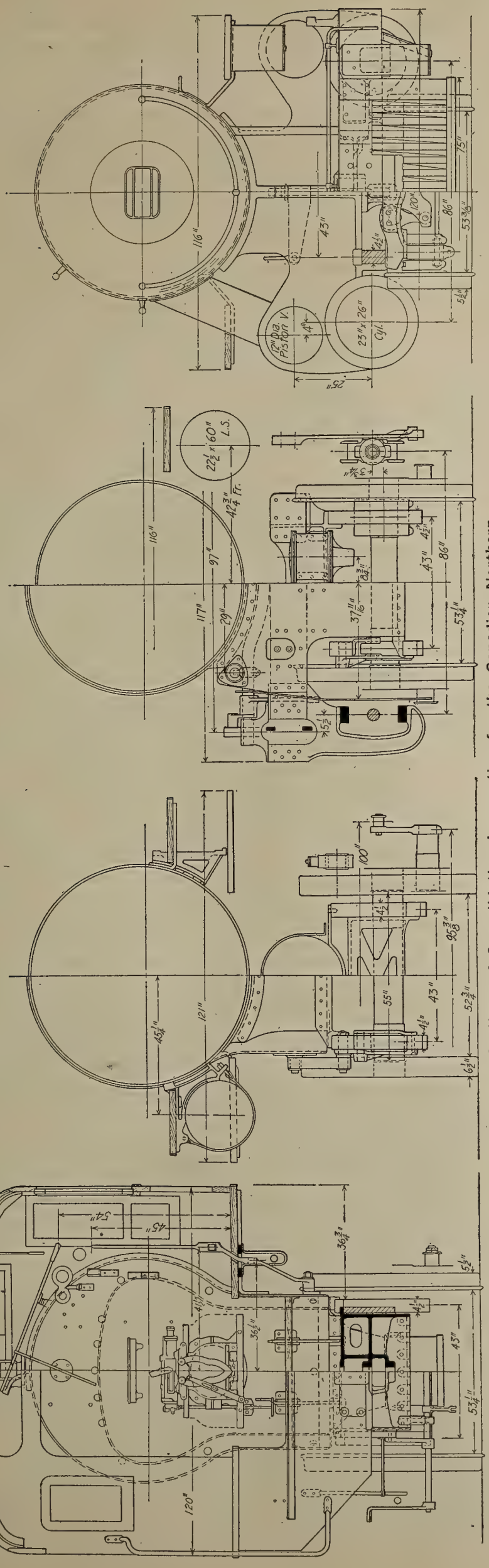
It is arranged to deliver coal onto locomotives on four tracks passing beneath and along one end of the station. Run-of-mine coal can be taken on any one of these tracks, while on two tracks passenger coal can be taken and on another the stoker coal. The locomotive coal is received on a track passing one end of the station, the coal being dumped from the cars into a concrete pit and elevated by an inclined balanced skip hoist. The two skips are of 5 tons capacity each and capable of elevating 125 tons of coal per hour. The electric motor operating the hoist is controlled automatically.

Provision is made for overhead storage of 20 cubic yards of dry sand with suitable pipes for delivering sand to the locomotives on any one of the four tracks.

Green sand storage of about 1,200 cubic yards is provided in a sand house nearby the coaling station. The sand is dried by steam driers and elevated into overhead storage bins by compressed air. All buildings are completely encircled by a 6-inch fire line supplying fourteen 4-inch, two-way fire hydrants.

About 3,000 feet of water pipe varying in size from 10 inches to 14 inches was laid for supplying three penstocks erected for supplying engines passing to and from the new engine house. This was connected to existing water tanks and a 12-inch branch furnishes the power house with water.

The work was designed and constructed by Westinghouse Church Kerr & Company, of New York, under the direction of M. A. Long, assistant to the chief engineer, as representative of the railroad company.



Sections of Consolidation Locomotive for the Canadian Northern.

CONSOLIDATION LOCOMOTIVES, C. N. RY.

The Canadian Locomotive Co. has delivered to the Canadian Northern Ry. twenty-five consolidation locomotives for freight service, equipped with the latest type of superheater. These locomotives weigh in working order 188,600 pounds and are of the usual type of consolidation engines, with semi-wide fire box over frames. Three hundred and forty-four flexible stay-bolts are used in the breaking zone of fire box. The ash pan is of the Canadian Northern style of hopper bottom. Outside steam pipes are used, incased within an airtight jacket secured to cylinder and smoke box. This arrangement eliminates most of the obstruction in the smoke box met with the inside steam pipes. The locomotives are equipped with Pyle-National electric headlights. The boiler is fed from the top through an arrangement of check valves in base of bell stand, which is standard on this road. The tender tank holds 6,000 imperial gallons of water and twelve tons of coal. The frame is built of 10 x 13-inch steel channels. The tank is of the outside equalized type, with a cast steel bolster. The equipment includes Westinghouse brake E. T. No. 6 and the Franklin fire door opener. The following are the principal dimensions:

Tractive effort	35,000 lbs.
Weight in working order	188,600 lbs.
Weight on drivers	163,000 lbs.
Weight of engine and tender loaded	332,600 lbs.
Wheel base rigid	15 feet 6 inches
Wheel base engine total	23 feet 9 inches
Cylinder diameter and stroke	23 feet x 26 inches
Piston valves	12 inches
Diameter of drivers	57 inches
Boiler pressure	180 lbs.
Boiler diameter at first ring	66⅜ inches
Fire box length and width	114 inches x 40¼ inches
Tubes, number and diameter	158—2-inch
Flues, number and diameter	22—5⅜-inch
Tubes, length	14 feet
Heating surface, tubes and flues	1,581 sq. ft.
Heating surface, fire box	179 sq. ft.
Heating surface, total	1,760 sq. ft.
Superheating surfaces, inside of tubes	345.5 sq. ft.
Grate area	31.8 sq. ft.
Weight on drivers ÷ traction effort	4.7 sq. ft.
Total weight ÷ traction effort	5.38 sq. ft.
Traction effort by diameter of drivers ÷ heating surface	1,133
Total heating surface ÷ grate area	55.3
Fire box heating surface ÷ total heating surface per cent	10.1
Weight on drivers ÷ total heating surface per cent	92.6
Volume equivalent cylinder cubic feet	12.5
Total heating surface ÷ volume of cylinder	140.8
Equivalent heating surface	2,278.23 sq. ft.

Personals

J. M. KILLIAN has been appointed storekeeper of the St. Louis Southwestern and the St. Louis Southwestern of Texas, with offices at Pine Bluff, Ark., and Tyler, Tex. He succeeds N. A. Waldron, resigned.

GEORGE TIER succeeds L. L. Collier as general foreman of the Atchison, Topeka & Santa Fe at Emporia, Kan.

JAMES L. BENNETT has been appointed purchasing agent of the Central of Georgia, succeeding Albert C. Mann, resigned. His office is at Savannah, Ga.

WILLIAM D. STOKES has been appointed general storekeeper of the Central of Georgia, succeeding James L. Bennett, promoted. His office is at Savannah, Ga.

D. DOWNING succeeds Charles B. Foster as general storekeeper of the Chicago & Alton at Bloomington, Ill.

E. O. COREY has been appointed foreman of locomotive repairs of the Chicago & Alton at Roodhouse, Ill.

G. P. TRACHTA, road foreman the Chicago, Burlington & Quincy, has been transferred from Sterling, Colo., to Sheridan, Wyo.

HOWARD TIMMEE has been appointed road foreman of the Chicago, Burlington & Quincy at Sterling, Colo.

R. WILSON has been appointed shop master mechanic of the Chicago Great Western at Oelwein, Ia. He succeeds G. M. Crownover, promoted.

H. BRINKMAN succeeds A. B. Clark as locomotive foreman of the Chicago Great Western at Oelwein, Ia.

SAMUEL L. KAMPS has been appointed assistant to Vice-President Garrett of the Chicago Great Western, with office at Peoples Gas Building, Chicago.

H. S. C. MACMILLAN has been promoted to master mechanic of the Chicago, Milwaukee & St. Paul at Minneapolis, Minn., succeeding W. Wratten, resigned.

JOHN TURNEY has been appointed general foreman, locomotive department, of the Chicago, Milwaukee & St. Paul at Minneapolis, Minn. He succeeds H. G. Dimmitt, promoted.

H. G. DIMMITT has been appointed assistant master mechanic of the Chicago, Milwaukee & St. Paul at Minneapolis, Minn., succeeding H. S. C. MacMillan. Mr. Dimmitt entered the Dubuque shops of the Milwaukee road as a special apprentice in 1903 and served in the shop and on testing work at various points for three years. He worked at building mining engines for a while after finishing his apprenticeship with the railroad and in 1907 was appointed assistant roundhouse foreman at Savanna, Ill. In 1908 he was appointed roundhouse foreman at Ottumwa Junction, Ia., and in 1910 was appointed general foreman at South Minneapolis shops, which position he held until the present appointment.

C. A. SCHUBERT has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha at Altoona, Wis.

JOS. MALTBY has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha at Omaha, Neb.

EDW. BOAS succeeds R. Q. Prendergast as master mechanic of the Cincinnati, Hamilton & Dayton, with office at Indianapolis, Ind.

J. S. HENDERSON succeeds J. E. O'Neil as foreman of car repairs of the Delaware & Hudson at Watervliet, N. Y.

E. R. LARSON has been appointed supervisor of apprentices of the Delaware, Lackawanna & Western, with office at Scranton, Pa. He succeeds R. B. Keller.

W. J. DAVIS succeeds J. W. Dellinger as general foreman of the Detroit, Toledo & Ironton at Lima, O.

O. S. THROOP succeeds B. Ferris as general foreman of the Detroit, Toledo & Ironton at Delray, Mich.

J. L. HODGSON has been appointed master car builder of the Grand Trunk Pacific, with headquarters at Transcona, Man.

GEORGE W. ROBB has been appointed superintendent of motive power of the Grand Trunk Pacific and the office of master mechanic has been abolished. His headquarters are at Transcona, Man., as heretofore.

W. E. JOHNSTON has been appointed car foreman of the Great Northern at Skyomish, Wash.

S. A. CHAMBERLIN, master mechanic of the Pere Marquette, has been transferred from Saginaw to Grand Rapids, Mich.

W. GRIFFITHS succeeds S. A. Chamberlin as master mechanic of the Pere Marquette at Saginaw, Mich.

THOS. KELLEY has been appointed road foreman of the Pere Marquette at Saginaw, Mich.

P. K. PIERCE has been appointed road foreman of the Pere Marquette at Saginaw, Mich.

D. T. WILLIAMS has been appointed assistant master mechanic of the Philadelphia & Reading at Philadelphia, Pa.

R. W. SCHULZE has been appointed superintendent of the car department of the St. Louis & San Francisco. His headquarters are at Springfield, Mo.

G. R. WILCOX has been appointed roundhouse foreman of the St. Louis & San Francisco at Birmingham, Ala.

E. D. MEISSONNIER succeeds B. T. Adams as storekeeper of the Yazoo & Mississippi Valley, with office at Vicksburg, Tenn.

L. J. COLLINS has been appointed general foreman of the Lake Shore & Michigan Southern at Nottingham, O., succeeding R. A. Fitz, promoted.

R. A. FITZ has been appointed general foreman of the Lake Shore & Michigan Southern at Sandusky, O., succeeding G. H. Hopper, transferred to another line.

W. T. MARTIN has been appointed general foreman of the Lake Shore & Michigan Southern at Alliance, O., vice L. J. Collins.

J. P. WELSH succeeds C. W. Ashman as roundhouse foreman of the Minneapolis & St. Louis at Marshalltown, Ia.

O. J. KELLY, master mechanic of the Baltimore & Ohio, has been transferred from Parkersburg, W. Va., to Newark, O., succeeding J. F. Bowden.

J. B. ELLIOTT, master mechanic of the Baltimore & Ohio, has been transferred from New Castle, Pa., to Parkersburg, W. Va.

J. J. MCGUIRE has been appointed master mechanic of the Baltimore & Ohio at New Castle (P. O. Mahoningtown), Pa. He succeeds J. B. Elliott.

J. A. MCGUIRE, general foreman, locomotive department, of the Baltimore & Ohio, has been transferred from Cleveland, O., to Holloway, O.

E. D. MORRISON succeeds W. W. Calder as general foreman, locomotive department, of the Baltimore & Ohio at Cumberland, Md.

W. W. CALDER succeeds T. M. Lillard as general foreman, car department, of the Baltimore & Ohio at Cumberland, Md.

J. H. AGAR has been appointed general foreman, car department, of the Baltimore & Ohio at Garrett, Ind.

C. B. HITCH has been appointed general foreman of the Chesapeake & Ohio at Hinton, W. Va.

A. H. TANNER has been appointed general foreman of the Chesapeake & Ohio at Logan, W. Va.

R. E. BRANSFORD succeeds C. B. Hitch as foreman machine department of the Chesapeake & Ohio at Hinton, W. Va.

J. A. BARKER succeeds G. E. Fuller as road foreman of engines of the Chesapeake & Ohio at Peru, Ind.

J. B. QUACKENBUSH has been appointed road foreman of engines of the Erie, with office at Jersey City, N. J.

R. W. SIMPSON has been appointed general fuel agent of the Intercolonial and the Prince Edward Island, with headquarters at Moncton, N. B.

G. F. SILVIA has been appointed general mechanical and electrical superintendent of the Albany Southern, with office at Albany, N. Y.

C. V. CARLSON succeeds J. H. Hanna as master mechanic of the Colfax Northern, with office at Colfax, Ia.

W. L. PROSS succeeds J. C. Homer as master mechanic of the Dayton, Lebanon & Cincinnati. His office is at Centerville, O.

JUDSON ZIMMER succeeds J. Sibbald as master mechanic of the Fonda, Johnston & Gloversville, with office at Gloversville, N. Y.

N. J. O'CONNER has resigned as master mechanic of the Florence & Cripple Creek.

F. C. CHAMBERS has been appointed superintendent of motive power of the Interurban, with office at Des Moines, Ia. He succeeds R. A. Foresman.

T. H. Y. NEWCOMB succeeds J. Pollock as master mechanic of the Jefferson & Northwestern. His headquarters are at Jefferson, Texas.

R. H. EREHART has been appointed master mechanic of the Missouri Southern with office at Leeper, Mo.

J. O. SNIVELY has been appointed master mechanic of the Monroe & Southwestern with office at Monroe, La. He succeeds C. C. Goodlett.

S. N. ACREE succeeds O. H. Thorsson as purchasing agent of the Natchez, Columbia & Mobile with office at Norfield, Mass.

J. E. HUTCHINSON succeeds W. R. O'Neill as master mechanic of the Payette Valley. His office is at Payette, Idaho.

E. TURBET succeeds A. Fortin as master mechanic of the Quebec Railway Light & Power Company, with office at Ste. Anne de Beaupre, Quebec, Can.

J. S. CALDWELL succeeds H. F. Dankel as general manager of the Rahway Valley. His office is at Kenilworth, N. J.

H. C. PIERCE succeeds H. C. Mackin as purchasing agent of the Tampa Northern with office at Portsmouth, Va.

C. J. STEWART has been appointed assistant mechanical superintendent of the New York, New Haven & Hartford with office at New Haven, Conn. He succeeds H. C. Oviatt, promoted.

G. A. MORIARTY, master mechanic of the New York, New Haven & Hartford, has been transferred from Providence, R. I., to South Boston, Mass., succeeding C. J. Stewart, promoted.

C. H. REID, master mechanic of the New York, New Haven & Hartford, has been transferred from Waterbury, Conn., to Providence, R. I.

E. W. ALLING, master mechanic of the New York, New Haven & Hartford, has been transferred from Taunton, Mass., to New Haven, Conn., succeeding W. S. Clarkson, resigned.

J. H. DALEY has been appointed master mechanic of the New York, New Haven & Hartford at Taunton, Mass. Mr. Daley was formerly road foreman of engines at New Haven.

F. W. NELSON has been appointed master mechanic of the New York, New Haven & Hartford at Waterbury, Conn., succeeding C. H. Reid. Mr. Nelson was formerly general road foreman of engines at New Haven, Conn.

G. S. WEILER succeeds R. W. Schulze as general car foreman of the Gulf, Colorado & Santa Fe at Cleburne, Texas.

T. W. COE succeeds W. J. Frauendiener as shop superintendent of the Lake Shore & Michigan Southern at Elkhart, Ind.

W. J. FRAUENDIENER has been appointed master mechanic of the Eastern division of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Bellefontaine, O., succeeding J. T. Luscombe, resigned. Mr. Frauendiener was formerly shop superintendent at Elkhart, Ind., on the Lake Shore & Michigan Southern.

M. K. TATE has been appointed assistant master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis at Bellefontaine, O.

E. H. WOOD has been appointed division car foreman of the Ontario division of the Canadian Pacific, with office at Toronto, Can. He succeeds F. E. Warren, promoted.

F. E. WARREN has been appointed general car foreman of the Canadian Pacific at Winnipeg, Man., vice T. G. Armstrong, promoted.

D. W. HAY has been appointed locomotive foreman of the Grand Trunk Pacific at Redditt, Ont., succeeding A. J. Roberts, transferred.

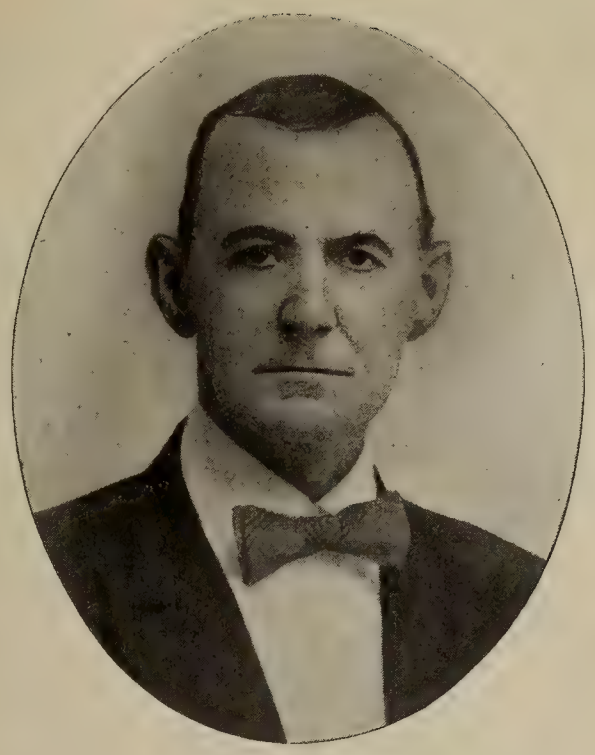
W. F. ROSS succeeds J. S. Little as road foreman of engines of the Baltimore & Ohio at Wheeling, W. Va.

F. HODNAPP succeeds Wm. Graff as road foreman of engines of the Baltimore & Ohio Southwestern at Flora, Ill.

H. C. OVIATT has been appointed superintendent of the Old Colony division of the New York, New Haven & Hartford, with office at Taunton, Mass. Mr. Oviatt was formerly assistant mechanical superintendent.

JAMES S. HENDERSON has been appointed general foreman, car department, of the Delaware & Hudson shops at Colonie and Green Island, N. Y. Mr. Henderson entered the railway field at the Green Island shops of the Delaware & Hudson on Nov. 25th, 1901, as a car plumber, one year later becoming air brake inspector. Two years later he was made M. C. B. bill clerk. During the year 1905 Mr. Henderson entered the piece work department under the supervision of Geo. C. Levee, general efficiency engineer, and later was appointed chief inspector of the Green Island shops. In 1909 he was appointed assistant supervisor of piece work department on the entire system, which position he held until his present appointment.

J. H. WATTERS has been appointed master mechanic of the Georgia Railroad, with headquarters at Augusta, Ga., succeeding John S. Cook, deceased. Mr. Watters was formerly assistant master mechanic at this point. He was born September 12, 1851, at Rome, Ga., and began railway work in 1868 as a locomotive fireman on the Selma, Rome & Dalton, now a part of the Southern. From 1871 to 1885 was an engineer on the same road. Later he was made master mechanic of the Anniston & Atlantic, and until January, 1892, was master of transportation and master mechanic of the same road and of the Anniston & Cincinnati. These roads are now a part of the Louisville & Nashville. In January, 1892, he was appointed master mechanic of the Louisville division of the Louisville & Nashville, and in October, 1901, went to the Georgia Railroad as assistant master mechanic, which position he held at the time of his recent appointment.



J. H. Watters.

H. R. WARNOCK has been appointed superintendent of motive power of the Western Maryland Railway, with office at Hagerstown, Md., succeeding C. M. Tritsch. Mr. Warnock commenced his railway career as a freight brakeman on the Pennsylvania Lines West in 1889, later serving as passenger brakeman on the Pittsburgh & Lake Erie. From 1891 to 1898 he served as a locomotive fireman on the latter road and from 1898 to 1902 as engineer. From 1902 to 1904 he filled the position of engine despatcher, roundhouse foreman and general foreman of locomotives and cars on the Monongahela division. In July, 1905, he was made master mechanic of the West Side Belt Railway at Pittsburgh, and in October, 1905, was appointed general foreman of the Monongahela Railroad, later being made master mechanic, which position he resigned to accept the appointment mentioned above.

A. COPONY has been appointed master car builder of the Grand Trunk at Port Huron, Mich., succeeding J. L. Hodgson, transferred. Mr. Copony started as a car designer with the Standard Steel Car Co. at Butler, Pa., where he had the good fortune to work under Chief Engineer Christianson. In 1909 he was appointed master mechanic of the steel car department of this company at Hammond, leaving this position to take charge of the die department of the plant of the American Car & Foundry Co. at St. Charles, Mo. In December, 1910, he was appointed chief draftsman, car department, of the Grand Trunk, which position he held until his recent appointment.

OBITUARY.

JOHN F. ENSIGN, chief inspector of locomotive boilers for the Interstate Commerce Commission, died at his home at Washington, D. C., on September 24, after a long illness.

New Books

LOCOMOTIVE BOILER CONSTRUCTION. By Frank B. Kleinhaus. Cloth, 6 x 8 inches, 462 pages, 5 insert plates. Published by Norman W. Henley Publishing Co., 132 Nassau St., New York. Price $3.00.

This book takes up modern practices in boiler work, giving

the best methods of large builders and railroads and gives careful attention to each step from the first mark on the sheet to the finished boiler. The work is taken up in the order in which the various parts of the locomotive boiler go through the shop. A number of methods are given for laying out the slope sheets and some 60 pages are devoted to laying out of various sheets. Following are chapters on punching, plate planing, bending, machining parts and riveting. A section on boiler details takes up the various forms of stays, grates, fire doors, throttle pipe connections, water spaces, front ends and fittings. The next chapter is devoted to assembling and calking. Following is an interesting chapter on boiler shop machinery. This section is heavily illustrated with half-tones of various types of machines, short descriptions of the operation of each and the class of work it is adapted to.

Some 50 pages are devoted to general tables of use to the boiler maker and the concluding chapter is a resumé of federal and state locomotive boiler inspection laws and the provisions for their execution, together with a number of questions on boiler inspection. The book contains a great deal of practical information of value to anyone who has anything to do with boiler work, is well written and illustrated and covers its subject very thoroughly.

SAFETY FIRST. By George Bradshaw. Paper, 5 x 7½ inches, 130 pages. Published by McGraw-Hill Book Co., Inc., 239 West 39th St., New York. Price 50 cents.

The writer of this book has had long experience in safety work and recently resigned as safety engineer of the New York Central Lines to engage in business as a safety engineer. The purpose of this book, as stated on a flyleaf, is "First aid to the uninjured." It contains about a hundred illustrations of matters which relate to the every-day duties of the railroad man, showing both safe and unsafe practices, together with subject matter explaining each illustration. The subject of safety on American railways is being given special attention by all railway men at this time and a study of this book will help to make its reader a safer man. Safer men are needed today.

UNIFIED INSTRUCTION AND EDUCATION FOR RAILWAY EMPLOYES.

Fourteen years ago the International Correspondence School, of Scranton, Pa., arranged with the Delaware, Lackawanna & Western Ry. for the systematic instruction of its employes. In addition to the regular correspondence courses pertaining to the individual work of the employe, instruction was given in air brake operation by the employment of air brake instruction cars designed by them for this purpose and containing operating equipment for a fifty-car train. From time to time, as this work developed, other features were added to these cars, including electric dynamos for headlights and car lighting. The illustration shows one of these instruction cars. Expert railroad men accompany these cars, taking special pains to explain all difficult points to the railway department students, this service being free to them.

Instruction Car, operated by the International Correspondence School.

This system of instruction has been in vogue on the Canadian Pacific for many years. Within the past two years the service was further elaborated on by the appointment of special instructors to assist apprentices through the regular correspondence course of study pertaining to mechanical drawing and machine shop practice, with good results in added efficiency all along the line.

No department of railway service is slighted in the I. C. S. courses. Just how completely the entire range is covered is indicated by the following list of scholarships (Exhibit B):

Accounting Department—Complete commercial, bookkeeping, speed practice (for stenographers), commercial law.

Traffic Department—Advertising, salesmanship, law for corporation officers.

Operating Department—Law for business men, railroad (civil) engineering, telephone and telegraph engineering, locomotive and air brake, trainmen's.

Mechanical and Car Department—Mechanical engineering, electrical engineering, machine shop practice, toolmaking, foundry work, patternmaking, blacksmithing and forging, mechanical drawing (for apprentices), boilermakers', draftsmen's, complete gas engines, electric lighting, dynamo running, interior wiring, heavy electric traction, steam-electric, engine and dynamo running, steam engineering, stationary firemen's, steam fitters' complete plumbing, complete heating, locomotive engineers' locomotive firemen's, air brake, round house, carmen's, lettering and sign painting.

Maintenance of Way Department—Building foremen's, civil engineering, railroad engineering, surveying and mapping, chemistry and water softening, concrete engineers', structural engineering, bridge engineering, structural drafting.

It is patent that a systematic course of instruction to all employees of a railroad from one source has every advantage over knowledge gleaned from many and varying sources. It makes for united efficiency while greatly reducing the cost of such instruction to the individual. Every railway official should be interested in the advancement and consequent added efficiency of the employees under his jurisdiction. The plan offered by the I. C. S., and which is in successful operation on the Canadian Pacific, Delaware, Lackawanna & Western and other roads, makes it possible to bring all departments of any road to a much higher plane of efficiency by simply extending their co-operation and moral support in the work. A book entitled "Railway Courses," published by the International Textbook Co., Scranton, Pa., describes the varied courses in detail.

One of the cars above mentioned and illustarted herewith is 76 feet long over all, and is supplied with the following apparatus: A high-speed equipment; a double-header engine equipment; a 32-car train of freight brakes, having an average length of 36 feet of train pipe between each brake; a 10-car air signal; a 9½-inch Westinghouse pump, with an extra sectional upper head connected above it and working in tandem; and all the sectional valves of both the Westinghouse and the New York air brake. In fact, the car is equipped with everything in the line of charts and sectional or tandem valves—including sectional lubricators, injectors, and valve-motion models—that will aid in making the operation of railway apparatus clear to the student.

At the end of each air-brake instruction car is a boiler room, in which is a 15-horsepower boiler that furnishes steam to a 9½-inch Westinghouse pump (which supplies air to a main reservoir of 42,000 cubic inches capacity); a Pyle-National Electric Headlight outfit complete (in the management and care of which students are given instruction); and a 50-light direct-connected electric dynamo (which furnishes light for the car).

Among The Manufacturers

STEEL ENDS FOR FREIGHT CARS.

Among those who early realized the trend in car construction was W. T. Van Dorn. Having spent years in charge of freight car repairs he noticed that the bulk of repairs were on account of bad condition of ends and realized that with heavier equipment and longer trains, a stronger car would have to be built. Five years ago, therefore, he brought the first steel end for freight cars, which is distinguished by its concentric corrugations. But little encouragement was offered

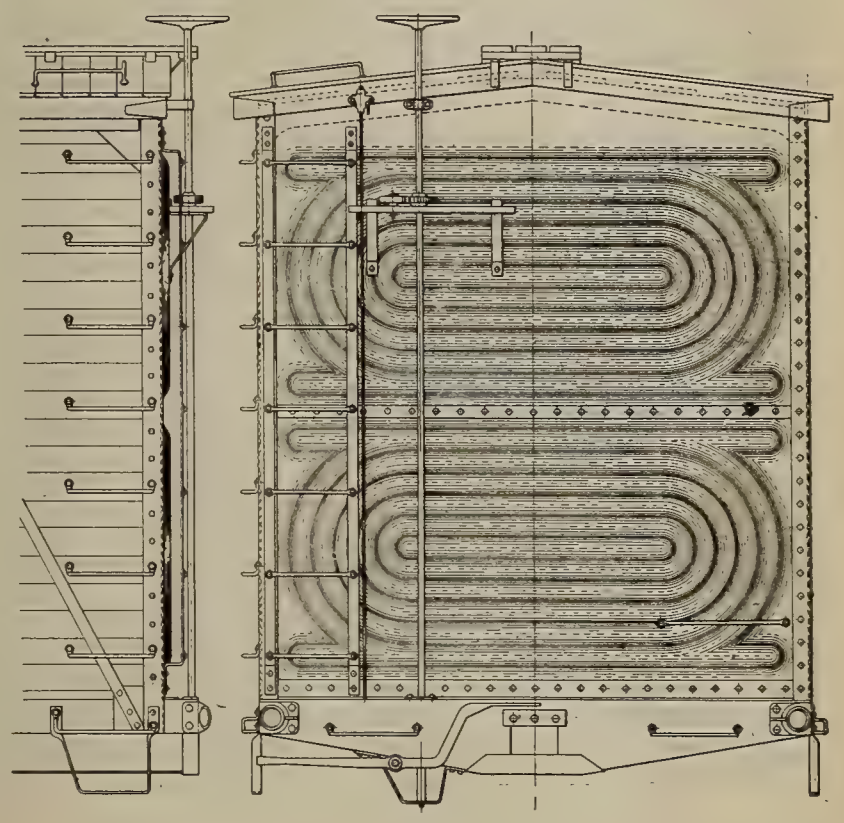
Van Dorn One-Piece End.

by the railways at first but the past year has seen a healthy growth in the steel end idea. These ends have proven after more than three years' continuous service that the target shaped end is the strongest form of construction and is capable of withstanding all stresses without damage. This is evinced by the fact that the Illinois Central, after having an end in use for two years, recently placed orders for 600 one-piece ends.

In order to meet the demands of those who desired a two-piece end the W. T. Van Dorn Co., Chicago, has brought out a sectional steel end, which is next in merit to the one-piece end. As may be seen in the illustrations, the corrugations in the two sections of this end follow the construction of the one-piece end as closely as possible. It is made of heavy pressed steel, the two sections being riveted together at the center. The ends are further reinforced by tie rods at the top, which are continuous throughout the car and pass through both ends. This is a special patented feature of the Van Dorn ends.

DURBIN TRAIN PIPE CONNECTOR.

The Durbin train pipe connector is a practical device for coupling and uncoupling air and steam hose automatically and at the same time it will connect a telephone system between cars. The device is fool proof and requires no attention whatever. The details are shown in the drawing. The connector is of the butt face type and is suspended from the car by carrying irons (attached to bracket D) independent of the draw bar. The face of the connector when uncoupled, extends 3½ inches beyond the inside car coupler pulling face. The



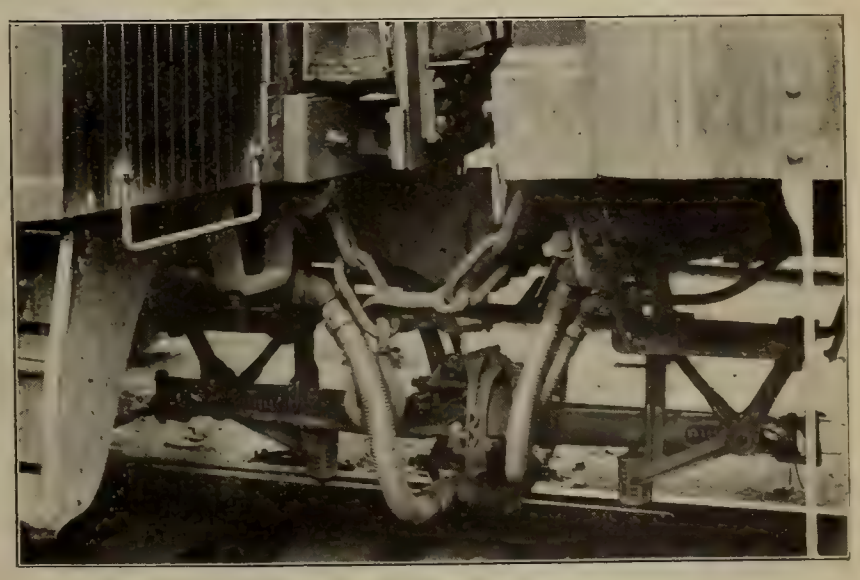
Van Dorn Two-Piece Steel End.

head (A) is pivoted to a main shaft (B) containing a vanadium compression spring (C) 2½ inches in diameter.

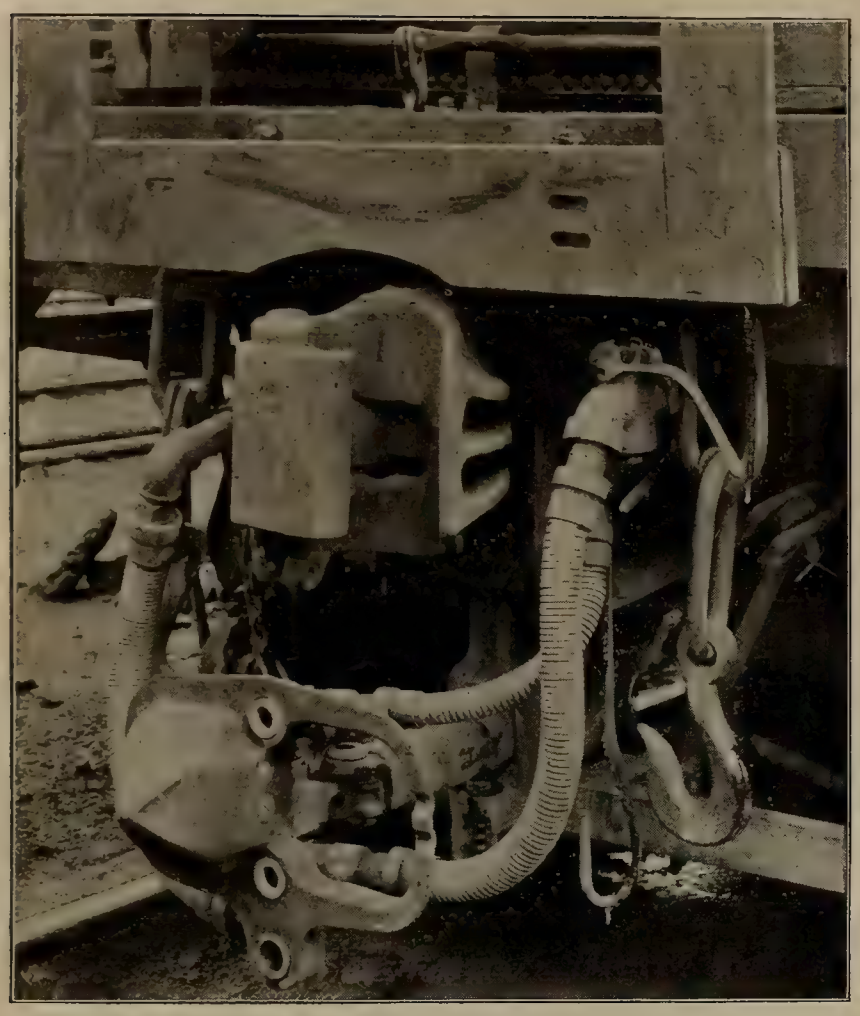
When the connectors are coupled the compression on the face is 1,600 pounds. There is a positive lock (F) on either side of the connector head which automatically locks and unlocks the heads. The gathering range of the connector face is 4 inches vertically and 6 inches laterally. The vertical movement of the connector when coupled is 10 inches. The curvature allowed for is ample for the shortest possible curve, and the connector will couple and register when draw bar slips by.

The connector clears the rail 6¾ inches and the draw bar 5 inches. Gaskets can be replaced without the separation of cars. The nipples (I, J & K) are held in place by a clamp (L) and in order to remove them it is only necessary to loosen a nut on the back of the connector head, which allows the clamp to be turned to one side. Telephone connection is made automatically by two contact posts (M) which are situated on the inner face of the connector head.

The device is made of malleable iron and weighs 140 pounds. The Blue Grass Special of the Queen & Crescent is equipped



Durbin Connector on the Queen & Crescent.



Durbin Connector on the Queen & Crescent.

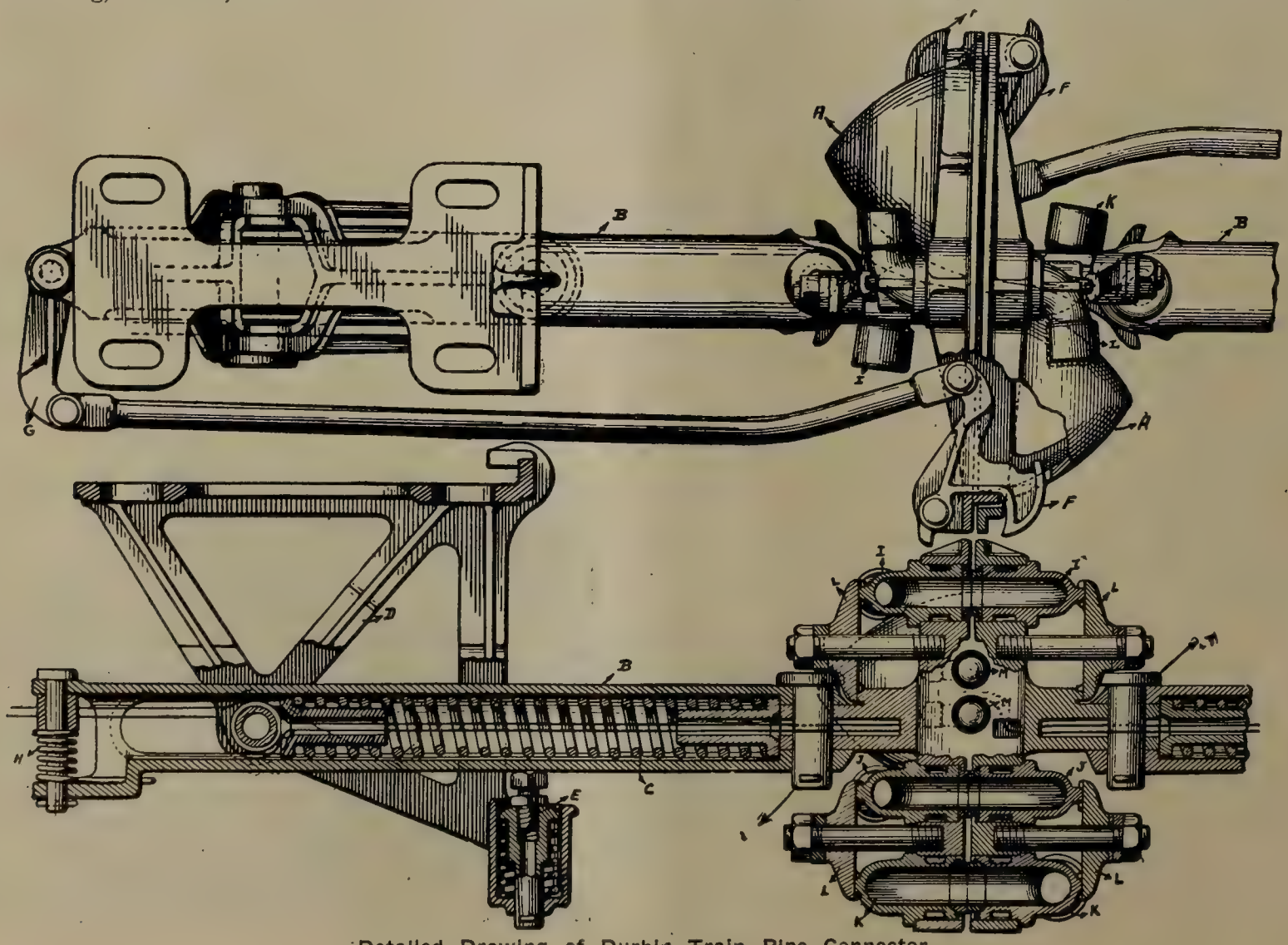
with the Durbin connector and it has been in successful operation for some time. It is a "Safety First" device as it does away with men going between cars to couple and uncouple hose and in addition to this it saves time in making up a train and also reduces the wear and tear on hose. The connector is handled by the Durbin Automatic Train Pipe Connector Co., Chemical building, St. Louis, Mo.

HEAVY FORGING MACHINE.

With the general adoption of high speed steels in machine tool operation, we are seeing a gradual re-design and development in the power and size of present-day machine tools, and through this, with the higher safety factors demanded in general engineering practice today, we are bound to see more radical and pronounced changes and improvements in practically all types of manufacturing equipment. In the railroad, automobile and industrial shop, for instance, we find a general tendency to the use of forged parts from iron, high carbon steel and alloy steels for the replacement of castings of steel and malleable iron, due to the greater strength possessed by the forged part, and also the fact that the forging is longer lived and cheaper when produced under proper conditions. The use of the high carbon and alloy steels, such as vanadium and the like, for making forgings is rapidly increasing and with this tendency we find, also, a marked effort to produce such forged parts more economically, i. e., with less operations, less heatings, etc., and this is bringing about the use of more powerful forge shop equipment, bigger drop and steam hammers, bigger forging machines and other equipment than was ever contemplated heretofore.

The National Machinery Company, Tiffin, Ohio, manufacturers of bolt, nut and forging machinery, has recently brought out a new design of forging machine which embodies radical departures, and will not only handle forgings more economically, but will operate on high carbon and alloy steels or wrought iron with equal facility. The machine is designed along lines that give it a higher safety factor than is customary in the forging machine. It has improved safety reliefs on both the gripping and plunger movements, and these features, combined with the other improvements embodied, are illustrated and described herewith, the illustrations being of the 4-inch size machine.

The bed-frame of the machine extends considerably below the floor line, and "under-ribbing" or girdered portion of the bed is very heavy and of massive section. This bed frame is a steel casting of the heavy pattern type, designed to secure a

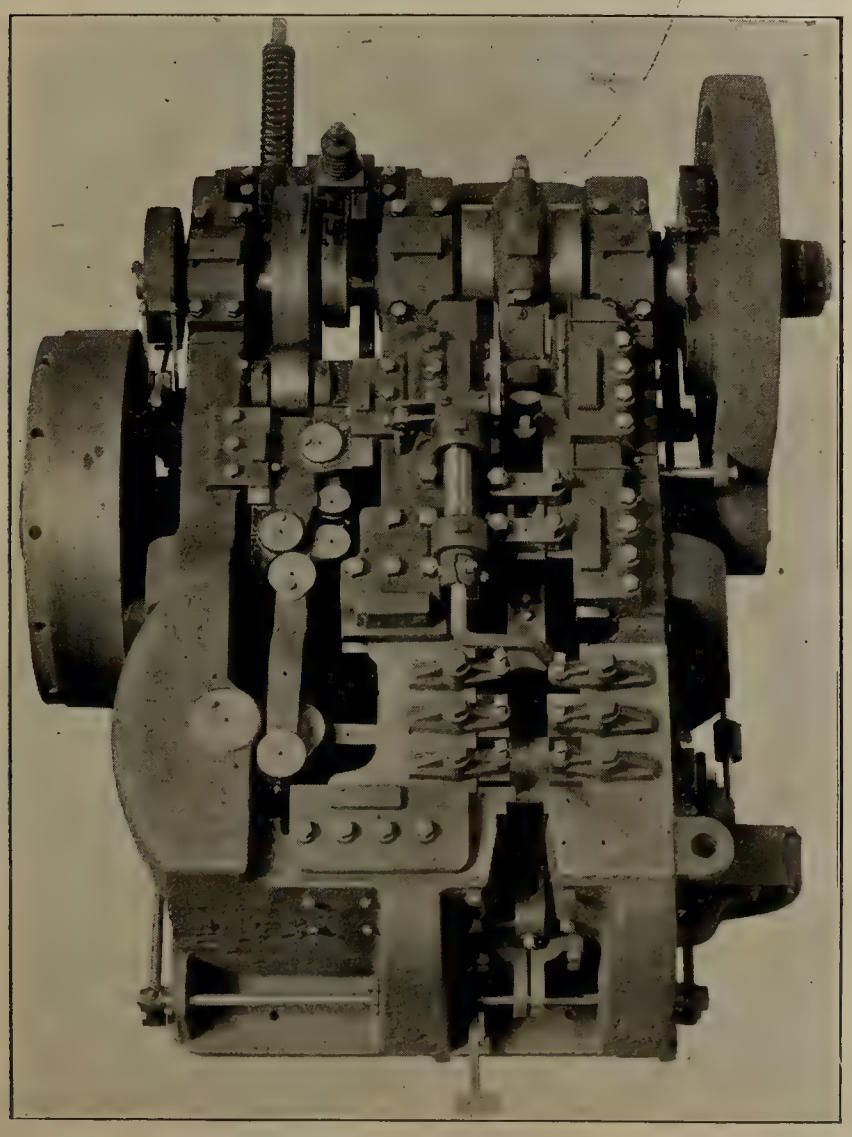


Detailed Drawing of Durbin Train Pipe Connector.

high degree of stiffness and rigidity as well as great strength, the aim being to so distribute the metal in the paths of the stresses as to overcome the objectionable spring prevalent in steel forging machine beds of lighter design, and also eliminate the use of tie rods and the like across the top of the bed at the gap or entrance to the dies and longitudinally. Spring in the bed frame, especially at the gap, is objectionable, as it weakens the gripping power of the machine, allowing work to slip, and is the origin of excessive fins and flash on the work.

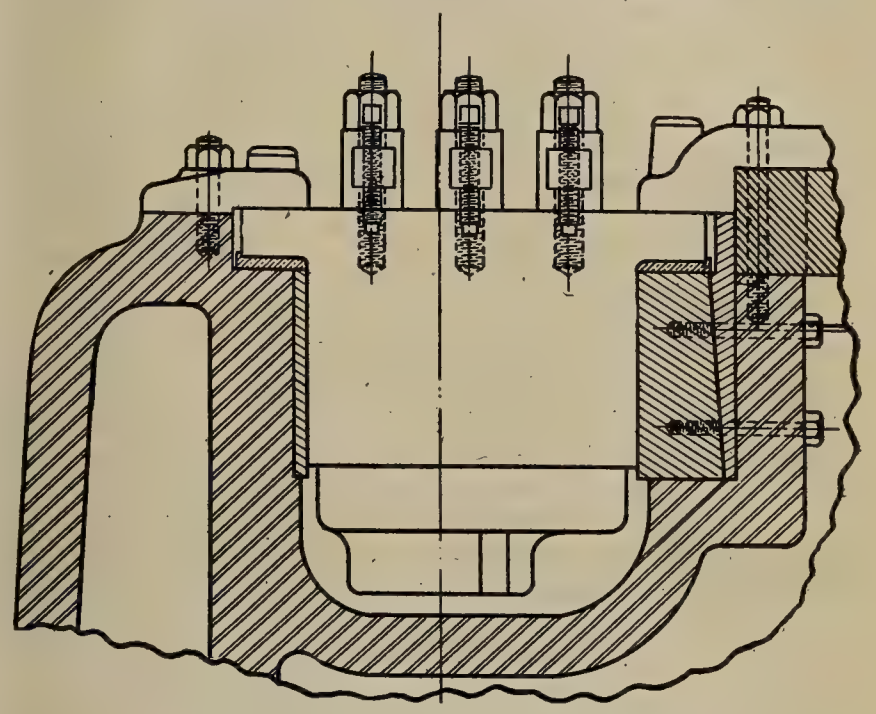
In the motor driven machine, the motor is geared direct to the flywheel, which is of the National "friction-slip" design. The National friction-slip flywheel, while primarily intended as a safety or relief on the heading or plunger movement of the machine, provides also that element of elasticity which is found essential between the motor and a machine of this type, due to the varying strains thrust upon the motor by the gripping and heading movements and the excessive strains when the machine is accidentally "stalled" by cold stock or excessive metal. This forms a compact and simple design, and the motor carries a rawhide pinion, thus insuring quiet operation, and also elimination of the excessive upkeep of the chain drive or flexible joint drive.

The top view of the machine shows the machine just as the grip dies have come to a close and the heading tool or plunger starts its gathering or upsetting stroke. As shown by this illustration, the heading movement is effected by a crank, while the gripping action is controlled by two cams, one cam controlling the forward or gripping movement of the toggles, and the other cam serving to open the dies. By employing two cams for the gripping movement, the opening and closing of the dies is so timed as to secure practically the entire stroke of the heading tool or plunger, thus giving the machine unusually large gathering capacity, i. e., the ability to upset a large amount of stock at one stroke of the plunger. This double cam mechanism also enables the dies to be opened wide, and this, with the large gathering capacity, enables the machine to handle large and difficult forgings with greater economy, as it necessitates less operations, hence less heats, to complete the forgings, and the large die opening facilitates the handling of upsets into and out of the machine.



Top View of National Heavy Pattern Forging Machine.

This top view photograph also shows the automatic relief on the gripping movement. This relief or safety is designed in the form of a by-pass toggle. This relief is designed so that but a small proportion of the gripping pressure or power is dependent upon the toggle and spring which holds the toggle in normal position, and does not relieve the machine until the same strains are secured in the dies which in other relief designs would shear the breaker bolt or pin. This gives a powerful gripping action in the dies and enables also the squeezing or swaging operations to be performed. The ability to handle such squeezing or swaging enables a wider range of work to be accomplished on the machine and is looked upon with much favor by forge shop superintendents. The relief resets automatically without shutdown of the machine or any attention on the part of the operator.



Section Through Suspended Gripping Slide.

Another valuable feature that has been incorporated in this design is the "suspended" type of heading and gripping slides, sectional view of which is shown. In this type of slide the supporting bearings are at the top in place of at the bottom of the slide, and this new idea removes the bearings from the line of water and scale which are so detrimental to lubrication and cause "cutting-out" of the slides and wearing plates and make it difficult to maintain good alignment. This sectional view also shows the wedge construction back of the side liners on these slides. With this construction shimming can be added as needed without removing the slides or liners and it is easy to maintain snug contact between the slide and liner and have perfect alignments.

The slide bearings, toggle and shaft bearings are of especially large area in this machine in an effort to minimize wear by facilitating lubrication; and the means for supplying lubricant to the various bearings has been carefully considered. Large oil boxes in the covers take care of the slides and the main shaft. Oil cups with connecting ducts take care of the bottom toggle bearings, and the "suspended" slides eliminate the source of greatest trouble in lubrication on the forging and upsetting machine.

This new heavy-pattern forging machine is built in sizes ranging from 2-inch to 5-inch capacity, but due to the large movements and greater strength of the design this range of sizes will safely handle any forge shop work that has been taken care of heretofore on so called 6-inch and various smaller size machines. A number of the 4-inch size machines are being built for automobile manufacturers and for railroad forge shops.

New Literature

The Shaw Electric Crane Co., Manning, Maxwell & Moore, Inc., 119 West 40th street, New York, has issued three bulletins as follows: Bulletin 82 describes the Shaw portable electric drag, single drum; bulletin 109 describes the Shaw type "Z" direct current crane motors, and bulletin 91 describes the Shaw electric crane for steel mill service. The portable drag is well adapted for handling cars in repair shops. The type "Z" motors are series wound and develop a high starting torque.

* * *

The Moore Patent Car Co., St. Paul, Minn., has issued a new catalogue dealing with the Moore system, which is a combined refrigeration, heating and ventilating system for freight cars. This system does away with end ice compartments, giving a greater loading space with a saving of almost 50 per cent in ice.

* * *

The National Tube Co., Pittsburgh, Pa., has issued bulletins Nos. 16 and 17. Number 16 is devoted to the properties of "National" stationary and marine boiler tubes, both seamless and lap-welded. Number 17 is a booklet of some forty pages and contains extracts from an address made to the United States Naval School of Marine Engineering by J. H. Nicholson, Associate, and Emil Holinger. A description of methods of forming various articles from seamless steel tubing is given, together with the process of its manufacture.

* * *

Bulletin 100, issued by the Pawling & Harnischfeger Co., Milwaukee, Wis., is entitled "The Plant and Its Products." Its object is to give an outline of the equipment of the firm, together with short descriptions of the types of machinery built, which include horizontal drilling and boring machines, I-beam trolleys, electric hoists, traveling shop cranes and, in fact, cranes of all descriptions.

Industrial Notes

Manning, Maxwell & Moore, Inc., New York, have purchased the capital stock of the Putnam Machine Co., Fitchburg, Mass.

D. P. Lamoreux has resigned as president and general manager of the Beaver Dam Malleable Iron Co., Beaver Dam, Wis., and will engage in other business. He is now located at 1658 McCormick building, Chicago, Ill.

A. D. Wyckoff, efficiency expert of S. F. Bowser & Co., Fort Wayne, Ind., with office at Pittsburgh, Pa., has been made eastern railroad representative of that company, succeeding Frank T. Hyndman, who recently resigned to become superintendent of motive power and cars of the Wheeling & Lake Erie. Mr. Wyckoff has been with the Bowser Co. for a number of years, and has had a wide experience in designing equipment for the handling and storage of oils, as well as oil filtering and circulating systems for railroad and manufacturing institutions.

The National Steel Car Co., Ltd., Hamilton, Ont., has opened offices in the Shaughnessy building, Montreal, Que., with George Condon as representative.

F. C. N. Robertson, general auditor of the Pullman Co., died September 9 in Montreal, Que.

The Metal Treating and Equipment Co., Inc., has opened a plant at 834 Humboldt street, Brooklyn, N. Y., to do electro-galvanizing work by a new and improved process.

The recent destruction by fire of the pipe shop and a storage warehouse of the Ralston Steel Car Co., Columbus, Ohio, has in no way interfered with operations. Both structures will be rebuilt at once.

C. H. McCormick, for a number of years connected with the mechanical department of the Michigan Central, has been made district manager of the Standard Heat & Ventilation Co., Inc., New York, with office in Cincinnati, Ohio.

The Beaver Dam Malleable Iron Co., Beaver Dam, Wis., has filed a voluntary petition in bankrutpcy in the federal court at Milwaukee, placing its liabilities at $500,000, and assets at $65,000. Ernest E. Smythe, of Milwaukee, was appointed receiver.

Charles M. Replogle, assistant superintendent of the steel car department of the Cambria Steel Co., Johnstown, Pa., has resigned to accept the position of general manager of the Ralston Steel Car Co., Columbus, Ohio.

The H. W. Johns-Manville Co., New York, has opened a branch office at Galveston, Tex., where a warehouse will be maintained for distributing stock throughout Texas.

G. F. Cotter, formerly general superintendent of the Fort Worth & Denver City and recently vice-president of the National Lumber & Creosoting Co., Houston, Tex., has resigned his position to enter business on his own account. Page Harris, heretofore superintendent of transportation of the Texas & Pacific, succeeds Mr. Cotter.

C. C. Bradford, Sales Mgr. U. S. Light & Heating Co., New York.

C. C. Bradford, formerly manager of the Cleveland branch office of the U. S. Light & Heating Co., has been appointed sales manager of this company, with offices at 30 Church street, New York city. Mr. Bradford became identified with the U. S. Light & Heating Co. in 1909. After one year as manager of the New York branch office, he went to Cleveland for the purpose of establishing a branch office in that city. His appointment to sales manager comes after three highly successful years as manager of the Cleveland office.

R. B. Clark has been appointed acting manager of the Cleveland branch office succeeding Mr. Bradford. The U. S. Light & Heating Co. has experienced a rapid growth since it was organized four years ago and is today one of the leading factors in the manufacture of specialized electrical apparatus, such as storage batteries, electric starters and electric train lighting devices.

John C. Kuhns has resigned as purchasing agent of the Illinois Central and has been appointed vice-president of the Burden Sales Co. He is associated with Fred Gardner in representing that company, the Pearsall Company, and the Oxweld Railroad Service Co., with offices at 341 Railway Exchange building, Chicago, Ill.

The Canada Iron Corporation, Fort William, Ontario, has announced its voluntary liquidation. The company has six large plants in Canada, manufacturing car wheels, brake shoes, sewer

pipes, etc., and owns several iron mines. It is stated that the company will probably be reorganized.

The Bush type of train shed, invented and patented by Lincoln Bush, E. D., 1 Madison avenue, New York, has been adopted as standard by the Canadian Pacific and will be used to cover the 11 tracks of its new Windsor street station at Montreal, Que.

Otis Funderburk, formerly Michigan manager for the Rayfield carbureter, has been appointed sales manager of the carbureter division of the Detroit Lubricator Co., which is making and marketing the "Stewart" carbureter.

The Conley Frog & Switch Co., Memphis, Tenn., it is reported, is arranging to establish a branch in Port Arthur, Ont. According to the agreement with the city the initial cost of the plant is to be at least $50,000. The company will receive a cash bonus of $25,000 upon the completion of the plant and a lease of ten acres of land, with sufficient water front to provide for dockage facilities.

Isham Randolph, consulting engineer, Chicago, Ill., has removed his offices to suite 1807, Commercial National Bank building, Chicago, Ill.

The Safety Appliance Co. has been incorporated in Ilinois with capital stock $25,000. M. Brown, E. Brown and A. P. McArthur are named as incorporators.

Fred H. Daniels, chairman of the board of engineers of the United States Steel Corporation, chief engineer of the American Steel & Wire Co., and president of the Washburn & Moen Co., died at his home at Worcester, Mass., August 31, after an illness of about a year. He was 60 years old. F. H. Daniels had been prominently identified with the development of the steel industry for forty years and 151 patents, many of the revolutionizing processes of manufacture, mark his influence on the industry.

Fourteenth Annual Convention, Chief Interchange Car Inspectors and Car Foremen's Association.

The fourteenth annual convention of the Chief Interchange Car Inspectors and Car Formen's Association of America was held at the West Hotel, Minneapolis, Minn., on August 26, 27 and 28, 1913. The first session was called to order by President J. L. Stark and prayer was offered by the Rev. Lawton of the Episcopal Church. The president then introduced Wallace G. Nye, Mayor of Minneapolis, who spoke in part as follows:

Address of Mayor Nye.

Minneapolis this morning, dressed in her finest summer gowns and with the purest atmosphere that nature can bestow upon a people, bade me come to you and bring you her fairest salutation and her most cordial greetings. She bade me express to you a welcome more cordial than I can find language to express. She trusts that your stay with us may be pleasant; that all the conveniences for the transaction of your business may be found here; that you may enjoy yourselves, and she bade me say to you that if there were anything omitted in the arrangement that seemed necessary to contribute to your comfort and pleasure, she hoped you will attribute it, not to lack of interest on the part of her city, but to her youth and inexperience. Minneapolis is a maiden of rather tender years. A half century marks practically the whole of her life, and the half of that period marks a period of her growth and development, so she is glad to have men and women of all parts of the United States come to her. She realizes that few impressions are so lasting as those which are formed through the exercise of our sense of sight. The beauty of the heavens, the grandeur of the old ocean, the magnificence of the mountain peak, cannot be described to us. They can only be appreciated when we have looked upon them. And so Minneapolis is extremely glad to have you come and see her manifold charms. She is a young city but has grown in commercial importance and she is extremely glad to welcome an association of men whose work has contributed and is bound to contribute in the very nature of things to the development of the great commerce of our country, and commerce is the means by which cities are built up and developed. So she is glad to have this particular association come because of the influence you exert in moving the wheels of commerce rapidly and promptly, and seeing that all parts of the country are served, and she is glad to have these men come because they are organized. We believe in organization—it is the great secret which nature taught to man and it is surprising to me to reflect that the world went on for so many years before men of any particular calling or profession began to organize and get together for their mutual advantage and the development of their calling or profession. Men all through the early history of the country were prompted by a feeling of selfishness, and professional men were afraid of their neighbors in business, but the last few years has brought them to feel that it is better to get together and work together.

We hope your stay will give you an opportunity to look about our city and see what a few years has wrought in this Northwestern country. I understand that this is the first time that this organization has come West of the great body of waters. Minneapolis is supremely honored by having the opportunity of entertaining you in this first visit to the West, and we hope that you will not only have an opportunity to see the great factories, mills and transportation facilities which have combined to make Minneapolis great commercially and industrially, but we want you especially to see the things that Minneapolis is doing toward the development of the character of the city. I want you to take that thought back home with you that the things that cities are doing today that is most important to my mind are the things they are doing to make the city a better place in which men and women can live; the provision they are making for educational opportunities, for parks and playgrounds and public baths and all sorts of opportunities for the development of the physical wellbeing of the people and mental development, which are the things worth while, and the city which is most progressive today is the city which is doing most along these lines of development.

I did not suppose, when the invitation was extended to me yesterday, that there were so many women connected with this association. We welcome you just the same, and I think our welcome is a little more cordial for the ladies than for the men. I am not going through the formality of tendering to you the keys of the city, but we have changed the combination of our locks from time to time so that they can be opened by the key that you use in your calling. I am sure if I had the opportunity of turning the keys over to a body of men and women, I would not hesitate to put them in your hands, feeling

F. C. Schultz, Pres.

F. H. Hanson, V. P.

S. Skidmore, Sec.

Newly Elected Officers of the C. I. C. I. & C. F. Assn.

that you would do what we are trying to do in Minneapolis; that is, to promote those things which are elevating and uplifting, and to put a curb on those things which are debased and ignoble. We are trying to make Minneapolis a decent place in which men and women can live, and in which children can grow up, and we try to instill upon the children that there is something encumbent upon them and that is that they are fit to live in our beautiful city.

President Stark: I would like to call upon Mr. O'Donnell to respond.

Mr. O'Donnell: If a citizen is traveling through the country, at the large terminals generally the official he sees is the one in uniform, but if he makes a minute examination he will generally see an humble person going up and down the platform looking over the train, not looking at the people. The honest and good car man has the office of giving the last blessing; he raises his hand, and that is satisfaction enough.

In accepting the invitation of his Honor, the worthy Mayor, we accept it graciously, and I trust that our presence in your city will be replete with actions that will merit your approval. I am sure that such a beautiful morning should appeal to every one. I trust the ladies will thoroughly enjoy it. We are going to ask the entertainment committee and the members of all the committees to pay particular attention to the ladies. You do not appreciate how much effort they have made in coming here. It is a very strenuous trip—some came 2,000 or 3,000 miles—and we hope that they will have no time to think of the effort in getting here, but they will go home and think of all the pleasures they had while here.

I think I have responded as well as I can. I assure you that we accept the invitation and the freedom of the city in the spirit that it is given, and we hope that Minneapolis in the future will not be an infant city, but will be a metropolitan city, the same as our cities down East. God bless Minneapolis.

Mr. Boutet then presented retiring President Stark with the badge of office.

Mr. Berg: With your consent I would like to say a few words, as I have been requested to perform a mission. A year ago I persuaded William Cary, mill foreman of our Collingwood shop, to come. He, like all the rest, was very much pleased, in fact, beyond his expectation. He found the organization up to date with one exception—he noticed the absence of the usual emblem of authority so conspicuous and audible at all meetings, and at our last meeting he determined that he would make and present the president at this meeting with the only thing he felt the association was lacking, a gavel. He requested me to present this gavel to you, which I am pleased to do and I trust that you will accept it and that the association will tender Mr. Cary a rising vote of thanks.

President Stark: On behalf of the association, I want to thank you for this remembrance. Before the ladies retire I want to thank them for their presence. If there is one thing above another that has tended to make our meetings a grand success it is the presence of so many ladies. We hope that you will continue to come. I am sure if you attend one that you will continue to attend from year to year.

Before the ladies retire we would like to hear from Brother Boutet, who was really the originator of the association—I think the man who called the first meeting—and I would like to have him say a few words, referring particularly to the early stages of the organization and its growth up to this time.

Mr. Boutet: It certainly is very gratifying to me to see the progress this association has made. While it took a great deal of uphill work to get some of you to join the association and come to a meeting to see what there was to the organization, it did not require any solicitation to have you come back the next year, for you had a taste of the good that was in the association and you wanted more. You felt that there was a more thorough discussion of the M. C. B. rules and a better understanding arrived at than was possible to get in any other way.

I was one of the organizers of this association and I believe one of the men that put their shoulders to the wheel to give it a start, and now that we have climbed the hill and are on a good, well-ballasted, level road with a good pacific type engine piloting us, and I feel that we are bound to prosper and I feel as the little boy said: "Gee, but it feels good" to see how this body has grown, not only in numbers but in quality for among our number are some of the brightest minds in the car departments of the different railroads of the country today.

It will continue to grow, if the members will give the officers the help they have previously given, continue to attend the meetings, take part in all the discussions as they have previously, and especially continue to bring their wives and daughters, urging upon the new members to bring their wives, for the presence of the ladies, God bless them, at these gatherings more credit is due for the upbuilding of this association than to any other cause.

Address of President Stark.

I appreciate very much the privilege, and it is with the greatest pleasure that I welcome you to our fourteenth annual convention. We now meet to advance, by discussion in common, knowledge relating to safe and economical railway car interchange, the construction and maintenance of cars and shops, and to secure a thorough and uniform understanding of the M. C. B. rules.

To grasp all its details considering conditions existing today this is indeed a large proposition which will require executive ability, wise judgment, broad and intelligent grasp of situations, if in the end we hope for satisfactory results. It will require our best efforts. The cost of maintenance and operation of equipment has been and is on the increase and must receive the careful consideration of all car department employees. I would urge the members of this association first to be careful in reaching conclusions, and, secondly, that we uniformly carry out the conclusions reached. This is the purpose of our organization.

As a result of our deliberations in the past many of the conclusions reached by this body have had merit, have been looked upon with favor and have been adopted by those in authority who make the M. C. B. rules.

During the past year we have been working under rules generally quite satisfactory to all. The new rules effective October 1st I feel safe in saying are even more satisfactory, and we trust that all sections will be governed by them to the letter, avoiding all special agreements, and if this is done few changes will be desired.

During the past year death has invaded the ranks of our association calling from active work friend J. A. Bradley, of Buffalo. Appropriate resolutions will be reported later by committee.

I cannot find words to properly express my appreciation of the work done by the entertainment committee who have provided for the members and guests of this convention a grand treat; to those who have contributed and made this possible, we are most grateful. Our thanks are also extended to our good friend Campbell and his Minneapolis coworkers for the invitation to come to this city and for their able assistance in completing arrangements; also to the executive committee and individual members for their co-operation and interest shown.

Report of the Secretary.

The secretary's report for year ending August 23, 1913, was as follows:

GENERAL FUND.

Receipts	$628.68	
Disbursements	606.49	
On hand	$ 22.19	$22.19

ENTERTAINMENT FUND.

Receipts	$254.68	
Disbursements	229.68	
On hand	$ 25.00	$25.00

The secretary read invitations from St. Louis and Chicago to hold the next convention. Thereupon a recess was taken until 2 p. m.

TUESDAY AFTERNOON.

President Stark: Before we take up the discussion of rules proper, we will have an address by T. H. Goodnow, superintendent car department of the Chicago & North-Western. He very kindly agreed to meet with us at this time, and we are glad to have him here.

Address of T. H. Goodnow.

When your good looking and smiling President asked me to be with you, he rather took advantage of me. He met me one day on the board walk at Atlantic City—I was in a hurry going one way, and he in another, and he asked me if I would come up here. He said he would write to me and I supposed, of course, he would write me and tell me what to say. I heard nothing from him until last Saturday, and then I found out he had been away on a month's vacation.

Starting in to talk reminds me of a little story told at Atlantic City, perhaps some of you have heard it: Mayor Stoy in one of his campaigns was making speeches around at the different wards and he started out each time by apologizing that he was no speaker. He noticed one gentleman always sat in the front row and appeared very much interested in what he had to say. As the campaign was drawing to a close he thought he would find out why this man was always there, so he went down and shook hands with him after the speech was over and told him that he had noticed he had been attending all his talks. The fellow said, "Yes, when I first started in I wasn't going to vote for you, but I am now." Mayor Stoy waited to see if he would not make some explanation of it, but he didn't. So Stoy says, "How is that?" "Well," he says, "I believe you are a truthful man." "How do you make that out?" "Well, every time you start out to talk you preface your remarks by saying that you are no speaker, and I will be damned if you are." That is about my case.

In reading over the minutes of the last year's convention I notice that practically your entire time is taken up with the discussion of the M. C. B. rules. I do not believe that this body of men could take up any more important subject and thresh it out than these rules. Coming as you do from all parts of the country, it brings about an interpretation of the M. C. B. rules that probably could not be had in any other way. The rules, as we all know, are made as a law for the country at large. They are not for any one locality or any one district, and they should be interpreted the same all over the country. The present tendency at the larger terminals, anyway, is for joint inspection and under joint inspection one man is in charge. He represents all of the companies and has his troubles no doubt with the local foreman of each company, but the rules as they are formed, should be interpreted the same and in having a joint inspector, or a chief joint inspector in charge, at least leads up to such results. This I think is fast leading up to another proposition in which the chief joint inspector, or his corps of assistants will have to be the educators of the local inspectors in the various railroad yards. There are quite a number of points at the present time where the car inspectors themselves are not individually with the railroads any more. In other words, they are put on the payroll as a joint inspection bureau and paid through a joint agency. This makes it important that the inspectors themselves be educated. We naturally look to the fellow on whose payroll we are carried, and I believe if this is borne in mind and the chief joint inspector will carry it out through his organization, it will be a great help to the individual car inspector in the way of education. I do not know just how many terminals this system has been extended to, but it is going to be put in at Peoria the first of the month, and has been at Chicago for some time, and I believe at some of the larger terminals in the west. I do not know as it has become much of a system yet east of Chicago.

Another point that I have in mind is that I believe the tendency has been in the changes that have taken place in the M. B. C. rules of interchange within the last two years to continually loosen up. In other words, to keep business going. This is bringing the railroads or at least those that are occupying the position that I do, face to face with a pretty hard situation to handle. Under the rules as they are at present, if a car comes to a railroad and it is safe to carry its load, the railroad companies have to take it. Probably it is moving 100 miles or more out on their line and it goes forward to be unloaded. In ordinary conditions or especially so in car shortage times, that car number becomes a car for the car service department and it is either reloaded or ordered to other parts on the line, with the result that it is kept on the line for months at a time, gradually developing defects and eventually it is impossible to either load it or properly handle it off of your lines. This is placing a burden on all roads at the present time in handling the foreign car equipment. If railroads had their stock so that they could repair cars regardless of the kind of car, it would be different, but they haven't. Each car has certain specialties, and the result is it is impossible to carry stock, and just such repairs as have to be made to get the car going are made. That I believe in a way accounts for the bad order system the country over, and that is one particular factor in my mind that I am sure will have to be taken under consideration in the next few years,—the maintenance of the car when it was away from home. I do not know how it can be worked out, but it is one that has got to be worked out, because cars that are in fair condition when leaving home and are away from twelve to eighteen months deteriorate on account of not being kept up; just making running repairs to keep them going. When you come to get that car and take it up with the car owner, you cannot satisfy him as to the condition, and you cannot satisfy yourself that you ought to make the repairs. It very often means practically the rebuilding of the car. I think that right here is a point that the chief joint inspector in the larger terminals which are the gateways of the great interchange of this country, should lend their best efforts to see that they are prepared when the time comes to make some rec-

ommendation to overcome this part of the trouble that the railroads are experiencing at the present time. Eventually it may come that cars which are reaching this stage that I just spoke of will have to be stopped and turned back. While I believe that the present home route rules are framed to overcome this, it is questionable how successful the rules will be, and especially from the fact that cars are bound to be reported under same, which, while probably in the opinion of the local man who has the cars in his yard, are in such condition that they should be destroyed when the report reaches car owner. He looks up his record and finds that the car is only eight or ten years old; he cannot consistently destroy the car—yet there is a car that practically has to be rebuilt. So it seems to me it is going to reach the stage where the car will have to be refused at some one point and turned back so that it will get to the car owner and be rebuilt or repaired by them.

I believe that, as I stated before, it will be a great help for the chief joint inspector, or rather his corps of assistants which are maintained probably in all of the large terminals at the present time to help the railroads out in this and this together with the education of the inspector in the yard are two of the important things the railroads are supporting you for. You cannot at all times put educated men out there and I fully appreciate that under the Interchange organizations that are being developed at the present time, that the inspector is going to look more and more to the chief joint inspector and his local assistants who visit the yard daily. I believe that is one thing that the railroads should insist that these interchange organizations carry out.

A car foreman who is as well included in this organization at the present time has his own trouble on the repair track, and it has been my experience, and I believe you will all have to agree with me, that his attention is confined there, and when he feels that there is an interchange organization practically in charge of the inspection end, he is more and more going to let go of the inspection in the yards and confine his efforts to the repair track, which I believe at the present time, with the majority of us is very necessary on account of the bad order situation. So it is going to be up to the Interchange Inspection organizations to practically carry on the inspection work and the education of the men.

I wish that in the deliberations of this convention that this handling of foreign cars which are practically down to the point where they should be shopped, will receive your consideration because I believe that best recommendations on the handling of these cars—and when you do that, it is for the best interests of the railroad—can come from organizations of this kind; men who are either themselves or their assistants daily in the large terminal yards and see the cars as they are. They are the men who know more about it than the fellow who is attempting to handle it and only occasionally going out and seeing it. (Applause.)

President Stark: I am sure we all appreciate very much Mr. Goodnow's kindness in meeting with us and giving us this talk. He has touched upon some matters that will come up a little later in our deliberations for discussion. We will be glad indeed to have Mr. Goodnow remain with us and take part in our discussions. We feel that a vote of thanks is due Mr. Goodnow. All who are in favor of the same will signify it by rising. Carried.

Mr. Boutet: In taking up the rules I move that we appoint somebody to read them and that we take up each rule separately. Motion carried.

Mr. Livingston was appointed reader of the rules by the President, while Mr. O'Donnell was asked to read the changes, if any had been made.

Vice-President Schults was asked to occupy the chair during the discussion of the rules.

President Stark: Before retiring I notice that there are quite a number of private car owners with us and I want to extend to them the courtesy of the floor and hope they will feel free to take part in the discussion. I do not know what is in their hearts, but they may desire to express themselves later on.

Chairman Schults: It was my idea to take part in the discussions and I can do it a great deal better as a member than if I am occupying the chair. There is a great deal of misunderstanding as to the old rules that have been in effect for a year, and some of which have not been changed. I hope that as these rules are read you will feel free to get up and discuss them. I know practically every one in the room but I cannot readily call the names.

RULE 1.

Mr. Boutet: I would like to hear an expression as to what you intend to do under the word running repairs.

Mr. O'Donnell: Running repairs means such repairs as are necessary to make the car safe to get to its destination, or part way. That is the way I understand the rule; it is simply yard repairs that are necessary.

Chairman Schults: I feel that where we come from we will construe this that when any railroad attempts to unload a foreign car upon its neighbor that has a broken center sill, they ought to make the repairs, and the car if empty will be refused. You cannot run the car without making repairs. Splicing the center sills and putting in end sills on foreign cars that are away from home is absolutely necessary in order to keep the cars in service, especially on the old wooden car. As I see it the particular construction of this rule will get good results, and there was no use in putting the rule in for the purpose of putting in bolts, wheels, etc.

Mr. O'Donnell: As I understand the rule, running repairs apply strictly to empty cars. Nobody is going to get on a lot of empty cars unless he has to. Running repairs simply means in the train yards. Work to get your loaded cars through. That is the way I have always termed it. I do not think you will do any repairs to the cars in general by this rule. The rule as it is changed, in my mind, will not increase the work on the cars to maintain them any better than they are now except by ordinary running repairs under load. I feel confident that the trucks and everything will be kept up better for the reason that instead of 85 per cent air, you have got to have 90.

Mr. Anderson: I do not believe it refers to empty cars. If you do make repairs to a foreign car or an empty car, you are supposed to make the proper repairs.

Mr. O'Donnell: I think our friend has become converted since he left Buffalo. We could not get him to put 50 cents' worth on a car then.

Chairman Schultz: The very reason this rule was amended, was to compel the railroad companies to make more repairs to foreign cars. One common defect is worn out center sills, and if this rule means anything it means as much as splicing draft sills and keeping the car in general running condition. I do not say that it means side sills or complete roofs or anything but the running gear. Any one attempting to unload a foreign car on his neighbor that he had for a long time and that has defects coming under this rule, ought to be refused and he ought to make the repairs.

Mr. Elliott: I do not see how you could expect anybody to take any cars with spliced center sills, because 75 per cent of the repair tracks are not equipped to handle that kind of work. You cannot very well expect a man to take a car in and if he could make it safe to run by putting in the nuts, and say to him that he has got to splice the sills.

Mr. O'Donnell: I think we are wrong to discuss this matter so long. We put in 50 or 100 sills in Buffalo every day. Every interchange point does the most of the work that they have time to do, but there isn't any money in repairing cars. Our chairman wants an interpretation of this rule as to how it should be carried out.

I move you that it is the understanding of this association that there should be no partiality shown on foreign equipment; that all repairs should be treated alike and kept up as far as possible.

Seconded by Mr. Boutet.

Mr. Helwig: I think it would be entirely out of the question for any of the roads to undertake to splice sills or do all the heavy work on foreign equipment. Especially on a good many roads through the South. They do not repair their own cars; they run them up north and most of the northern lines have cars in better condition than southern cars. It would be out of the question to take them out of the service and make the repairs. We are asking for home route cards daily to get them home.

Mr. Kipp: The gentleman is arguing on the question of empty cars. I do not think there is any question whatever on foreign cars. If a man receives a foreign car for loading, he ought to take into consideration the distance that he has got to move the car empty before it is loaded, and the distance that he has got to deliver the car back loaded before he receives it. If the car isn't in condition when he receives it empty to move the distance empty, and then move loaded and deliver to the receiving line, he should refuse it then and there; that would settle the question that we are arguing about entirely, as far as empty cars are concerned.

Mr. Zachritz: The discussion has gone beyond its scope. It simply says here that the railroad company should give foreign cars the same amount of care that they do their own for running repairs. If our line offers a connecting line a car with heavy bad order repairs and they have got to take it to the general shop to make the repairs, they have a right to transfer that car and send it back, and if it is an empty car and is not safe to put a load in, they have a right to send it back. I think it is simply an admonition to all railroads to make an attempt to keep the foreign cars in good repair. I do not think it applies to applying draft timbers and applying end sills. It simply means light running repairs on those cars that would not have so many heavy repairs.

Mr. Helwig: We talk about making heavy repairs. As I understand the rule it means ordinary running repairs. Of course we know we have all got to splice center sills. At my point we get on an average 100 cars a month that I have got to splice center sills in order to make them safe. It is not because I want to. I have on an average 15 waiting home route cards. If we let them get away they go down 100 miles; that man gives the cars a load for 200 miles further and so it continues and there is no end. It will have to come to a place where it will be stopped or sent home.

In regard to oiling, I understand we are to oil a car and keep it in proper packing so that the journal boxes will run cool. Our road, and a good many others that I have heard from are repacking their own cars. Every 8 months they throw out all the waste, have it rendered, shape it up and put it back fresh. We know we could not do that to the foreign cars and there is no rule that says we have got to do it. You know there is quite a lote of foreign cars that really ought to be repacked.

Mr. Kipp: I coincide with him exactly as far as the car question is concerned, and the care. We start in a C. M. & St. P. car from Minneapolis, and we bill it through to Boston, and in its condition when loaded the center sills are worn and the draft timbers will play backwards and forwards four or five inches. It gets down to Mr. Schultz at Chicago and he lets it go down to Buffalo to Mr. O'Donnell. Possibly when it gets to Mr. O'Donnell he sees that there is one or two draft timber bolts broken; they put the draft timber bolts in and reload it on the New York Central, and it will go down to Utica, there is nothing left of the sills but a trough from the end sill to the body bolster. There is nothing to hold the draft timber bolts, but he says: "We have got it down here; we will deliver it to Kipp of the N. Y. O. & W." And Kipp has got to accept it. This gentleman who preceded me used the best argument that I have ever heard in this convention. The owner of a car should try to deliver his car to the receiving line in a condition to go; he should understand that it is to go 500 or 1,000 miles out loaded and 500 or 1,000 miles in empty and returned to him as a car. That is the argument we ought to get into, and the sooner we get into that way of thinking, the better conditions we will have as far as car interchange is concerned in this country. The car owner should deliver his car to a receiving line in a condition that he can say: "My car is now in a condition to go out 500 miles loaded and come back, if the receiving line does not see fit to reload it 500 miles."

Mr. Gainey: You made a recommendation to the Master Car Builders. They agreed to the first suggestion with the exception of the word "running" and inserted the word "repairs." The arbitration committee has taken the general scope as suggested, which makes it running repairs and not heavy repairs such as splicing sills and that class of work. If a loaded car goes to you, you are compelled to take it. The receiving line is the judge as to whether he receives an empty car or not. I think that is as plain as it could be put.

Mr. Carr: You are speaking of running repairs. The gentleman has talked on heavy repairs. If you are just discussing Rule No. 1 you will find out what you are going to do with heavy repairs. They have their repairs classified. They have light repairs, running repairs and heavy repairs. Such repairs as can be made in the yard by an inspector. I think in the next rule we will find out how we are going to get rid of heavy repairs.

The question was called for and the motion carried.

RULE 16.

Mr. Devaney: I would like to know how far you can go on that. Take for example a roof.

Mr. Boutet: You can put on a new roof and charge the owner if the car requires it.

Mr. Schultz: It is my understanding you can make any repairs to owners' defects and charge it up to the owner.

C. J. Strook: Where the roof is lost or shifted, unless the elements have removed the roof, you can go just so far as the roof is decayed. If the roof is decayed you can apply the entire roof new. We are applying them every day. We are also raising our roofs where the tin has become bent and shifted and spiking the upper groove down, making it safe, and letting it go to its destination, and when the car returns it will be delivered back home where it came to us.

Where a car has the running boards or one side of the roof only

loose, we have always applied the whole entire side and running boards, and never have been questioned as to the amount that we were allowed for repairs. When you come down to the finishing point, it all depends upon the condition of the material in that roof. A good many roofs are a good deal like a case of smallpox, a person hates to get near them. If you start at one point you do not finish until you get to the end of it. It depends upon the condition of the roof.

RULE 32.

Chairman Schultz: It is my idea under this rule that if a railroad unloaded a car and removed the brake staff it should be carded. But on the other hand if through the load or the breaking out of the end of the car, the brake staff was torn out—it is an owner's defect. It is hard to determine between the two unless you have personal knowledge.

Mr. Demint: A missing brake staff is strictly a car owner's defect unless there is evidence of unfair usage, and it is up to the receiving line to prove that the brake staff is missing by unfair usage.

Mr. Zachritz: Where do you get the authority that the receiving line has to prove unfair usage before it becomes a delivering line defect?

Chairman Schultz: It is my recollection that the arbitration decision referred to had reference to the handling line attempting to bill the owner for the brake staff.

Mr. Carr: If you go back to the rules you will never see a place that has ever said anything about the brake staff but what it was a delivering company defect. You take a twin load on two foreign cars; it is loaded with logs, and the shipper takes the brake staff off and fastens it to the car. In transferring it is lost. The load is unloaded and the car is put back in service; he brings it up to interchange point and they demand a defect card. They say it is owner's defect. Do you say that man must put that brake staff on at his own expense, and the rules have no place said that it was anything else but a delivering company defect.

Mr. O'Donnell: We have a number of these double loads and invariably when they arrive they put on a defect card at the time of removal. When they do not put on a card they go to isolated points in the country and the brake staff is thrown in the ditch; when the car comes back they naturally want a defect card. It is unfair service.

Mr. Demint: There is an old arbitration decision that says that the brake staff cannot be missing under fair usage. If you press the end out of a car and break the casing, doesn't your brake staff lose off?

Mr. Helwig: We all know that cars load in the steel mills or lumber yards, and double loads placed in them, that they remove two brake staffs or possibly one; they are thrown in the car and they lay there, do you think it fair that the owner be responsible for the old brake staff. I claim that it is unfair usage and that the brake staff should be carded. A brake staff cannot be missing under fair usage. If it is taken off intentionally, that is not fair usage.

Mr. Vitten: Arbitration decision 874 deals directly with this question. If it is done to accommodate the lading, then the delivering line is responsible, even though the brake staff be on the car, for the labor of replacing the brake staff; and if it be missing then the delivering line is responsible for the brake staff. Not alone the brake staff but any part of the car that had been removed to accommodate the lading.

Mr. Zachritz: So far as these rules are concerned it does not make any difference, if it were arbitration case No. 1 and the M. C. B. never amended that decision, it is still in force. That decision says that a brake staff cannot be missing under fair usage, and in the brake material missing in the present rule, you will note it always says under fair usage.

Mr. O'Donnell: I make a motion that a brake staff cannot be missing in interchange through ordinary service.

Motion seconded.

Mr. Carr: I do not understand Mr. O'Donnell's motion. The rules strictly say that a brake staff cannot be missing under fair usage. There is nothing else to it; there are no other conditions. Is it the sense of this body that we are going to interject something in the rules that that is not the proper interpretation of that rule? As I understand it a brake staff cannot be missing under fair usage and is a delivering company defect.

Mr. Lynch: Rule 54 reads: "Damage to any part of the brake apparatus." If you remove a brake staff that is not fair usage and should be considered a cardable defect.

Mr. Devaney: A man got up here and said, "Where we know it has been taken off." Even if that occurs every day, is it intended in the rule that they be all carded?

Mr. O'Donnell: I think we are talking against our own conscience that we should ask to charge the owner. We know we cannot charge him. The motion was carried. Thereupon an adjournment was had until

WEDNESDAY MORNING.

Mr. Boutet: I move that it is the sense of this meeting that if an opinion is agreed to by a majority of the members present that we all abide by what the majority says, and be governed by it as far as in our power, after we go to our respective homes.

Seconded and carried.

A committee composed of Messrs. Berg, O'Donnell and Stoke was appointed to draft suitable resolutions on the death of Mr. Bradley.

RULE 35.

Chairman Schultz: From the wording of this rule, it means the original construction of the car. In my opinion it also means that all cars will have to be stenciled at that time, the date they were originally built.

Mr. Zachritz: It is my opinion that any car passing through a shop practically rebuilt must comply in every detail to the safety appliance standard, and any car that does not comply in every detail has a penalty defect for every item. These cars could not go in interchange.

Chairman Schultz: Of course any car in service at that time will be equipped with safety appliances.

Mr. Zachritz: There are some of the standard that are not required to be changed until the cars are rebuilt. Any car that is rebuilt and does not comply in every detail to the rules for safety appliance standards, in my opinion, that car could not be offered in interchange.

Chairman Schultz: I would say that no car after October 1, 1915, that is not stenciled the date it was originally built can be offered in interchange. This is an important question. A man said to me that it was the understanding from what he knew about the rule that it was to apply to new equipment, but the wording of the rule is entirely different.

Mr. Zachritz: We go back to the time that the car was rebuilt, not the original construction. If that is a new car to be settled for it must be a new car when we interchange.

Mr. Berg: We do not have any trouble at any point. All these little things are taken care of at large interchange points without any trouble whatever. The only trouble we experience down east is on account of bad order, worn out dilapidated old cars. And we have in a measure overcome that, or will, if we comply with M. C. B. rules. I do not see that there is any necessity for all this argument. We simply convey to our superiors that we do not know our business and I know we do.

Mr. Helwig: A good many of us do not understand this rule. I do not for one, and I believe we should understand it; that is what we are here for. I am free to say that I do not know whether it is an old car that was built 25 years ago, or a car built 5 years ago, or one built at the present time. If it is all cars we have got to commence at once and stencil these cars.

Mr. Bossert: I believe that the rule means that all cars should be stenciled the date when built, so that an owner cannot come back and say that a car is 2 years old when it is 22 years old.

Mr. Livingston: It means all cars, and I move that that is the interpretation of that rule by this association.

Motion seconded.

Mr. Carney: What about rebuilt cars. I would say if a car is rebuilt and maintained after that date, it should be so stenciled. If the car is not intended to be used after Octoger 1st, it does not have to be stenciled.

Mr. Zachritz: If we have a car delivered in 1887 which is rebuilt in 1896, I maintain that it should carry the 1896 date.

The motion was carried.

RULE 39.

Mr. Elliott: What do you consider a draft timber substitute? We all know that as a rule the lug bolts, etc., are on the draft timber. When you put in a draft sill does that make it a substitute?

Voice: It still remains a draft sill, and it is only one item. If you have an end sill and one draft sill broken you would not have a combination.

Mr. Elliott: When the lug is placed on the draft sill, it is my opinion that in that case it would be a car owner's defect.

Mr. Demint: We have wooden cars with a short sill hopper bottom. I would like to have it discussed now. Longitudinal sills on cars with short sills, center sills that only go a short way beyond the body bolster.

Mr. Kipp: I think the arbitration committee has already decided that a longitudinal sill is one that extends from end sill to end sill.

Mr. Demint: I would like to be referred to the decision. I believe he has reference to a St. Louis case that was decided on a F. T. R. R. refrigerator where they called a short sill a liner block.

Mr. Hall: I think the case that Mr. Demint refers to is from Kansas City, that of a steel car, and the question was as to whether the draft sills running from the body bolster to body bolster were termed as draft sills where the metal draft arms are riveted from body bolster to end sill. The case that I remember of was one where a car was carded for one metal end sill bent and two draft sills bent. At some points it is termed that a metal draft sill that fails with the end sill, through ordinary handling and the blow does not break the coupler, that it is fair handling and it is due to corrosion and weak construction of the car, and some will card for an end sill broken and two metal sills bent; if the car is constructed with a metal body bolster that is riveted is it a combination of defects?

Mr. O'Donnell: It is wrong to issue a defect card for any damage on the end of a car unless you have to repair it. Agree among yourselves that you should not use cards for damaged ends unless the sheathing is torn. On all the light capacity cars you can always get permission from the owners.

Mr. Schultz: It is a question whether they are car owners' defects or not. It seems to me that the car owners should stencil the cars when they patch their posts or strengthen with plates so that they had positive knowledge that they did the work.

Mr. O'Donnell; They are always damaged from the inside outward. It would be folly to give away $15.00 for the end of that car. I do not think any official should ask you to card for a car if he knows in his mind that it went from the inside outward.

Mr. Demint: It says a combination of defects due to unfair usage. If you have four end posts broken it is an indication that the car is handled unfair and a defect card should be attached.

But going back to the repairs, I think if they be applied to corner posts and plated two end posts that I should deliver a defect card. We have an arbitration decision where a party applied two end posts and jacked back a corner post; that repairs to a combination and he got a defect card. At first the rule said "repairs" and lately they put in "repairs necessary," and I believe that means to repair bent end posts, not wooden posts.

Mr. O'Donnell: I consider a defect card the same as a personal bank check and I am not going to give away $15.00 or $20.00 to please some person's fancy. When the end bolsters are plated a car is unworthy of service. If it is a good car, a metal car, then you are getting into a combination. I could give away three or four thousand dollars a week on the ends of these old cars if we wanted to get down technically on both end and quarter post. We never use a card on our interchange unless it is necessary to remove the entire end, they then will see it and know positively that it is done from unfair service from outward, or request the owner to pay for it and we never get into any trouble.

Mr. Maupin: When you allow cars to be delivered in this condition for loading, which is often times the case, certain railroads reject them for the classification of loading that you intend for the line; they deliver the car and give instructions to their inspectors to card those cars for a certain district for a different class of lading. They turn these cars loose in that condition which accounts for the old traps being loaded. This gentleman from Cincinnati who has a lot of old cars, he isn't the only one. There are hundreds of them that become in a dilapidated condition because they allow them to go without repairs.

Mr. Livingston: I move you that it is the sense of this body that a car offered in interchange in which two end and two corner posts are broken and where posts are plated, that it is a combination and a cardable defect.

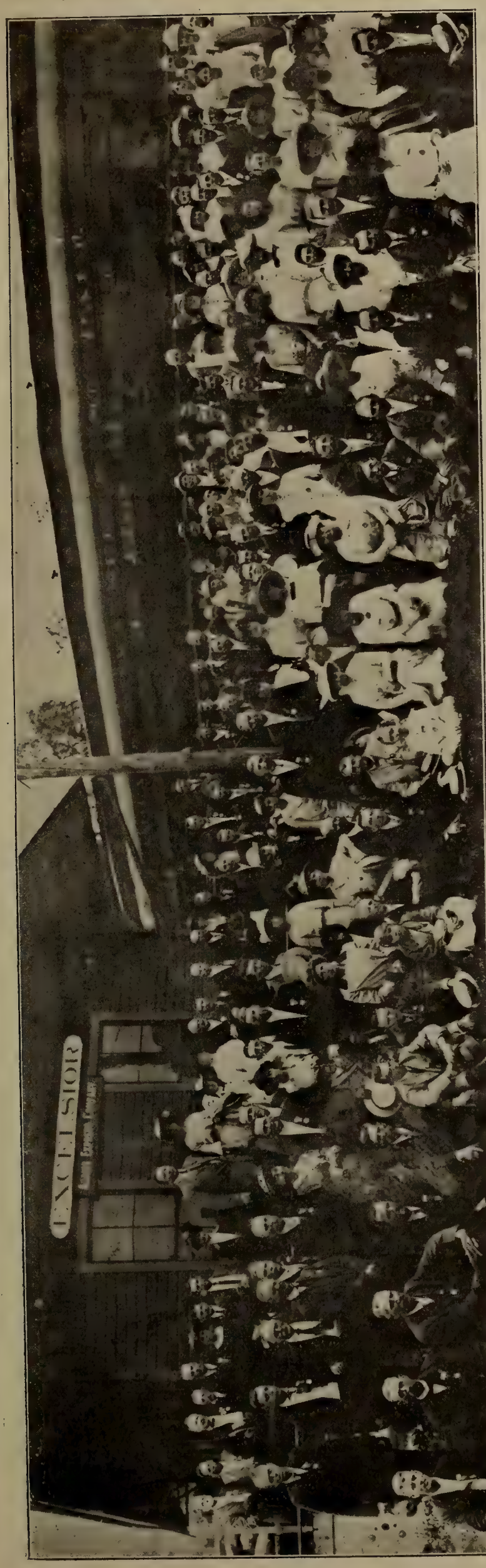
Motion seconded and carried.

RULE 43.

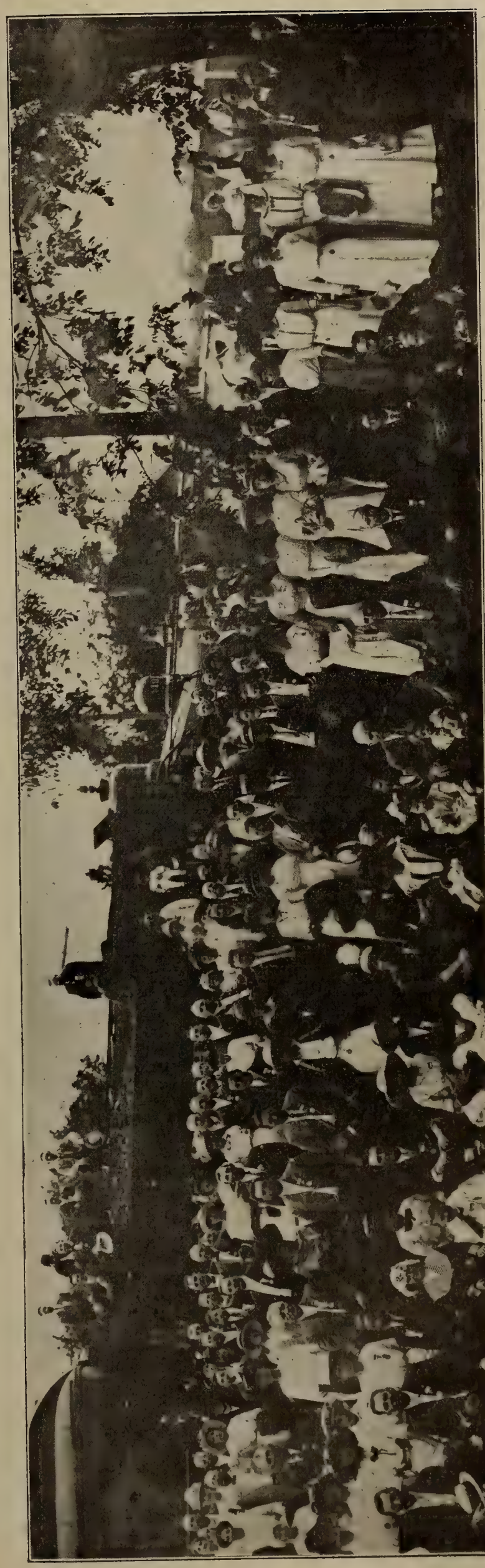
Mr. O'Donnell: I would like to ask the sentiment as to what you would consider concealed fire damage. Suppose you have two or three floor planks; you could not see them when it is under load; it is not concealed when it is empty.

Mr. Faver: Anything that cannot be detected from the outside is concealed.

Mr. O'Donnell: He cannot detect it from the outside but he has got to get down under the car and look it over. I am going to ask Mr. McMunn what we would do?



Members of the Chief Interchange Car Inspectors' and Car Foremen's Assn., and Visitors, at Excelsior Springs.



Continuation From the Right of the Above Picture.

Mr. McMunn: I would determine it concealed damage.

Chairman Schultz: It is understood that burnt damage on a car offered in interchange that is not visible from exterior inspection is concealed damage.

Mr. O'Donnell: I would like to ask Mr. Schultz what limit he would place on a bend to metal end sills on coal or hopper cars when they are in from three inches midway?

Chairman Schultz: In any case where the end sill was sufficiently damaged so as to interfere with the safety appliances or the safe work of the men, would be unfair service.

Mr. Demint: I will have to refer to the caption. You could give a metal car a severe shock and damage four sills and still it would be fair usage. I am inclined to believe under the caption of the rule it would be.

Mr. O'Donnell: I think the condition of the car in general should show an indication of the condition. I think the person handling the car and looking it over is the one to decide.

Mr. Hall: This was a steel car that was constructed with metal draft arms and were riveted to the body bolster and end sill and frame his metal draft arms are substituted for draft timber. I wanted to know whether it was car owner defect. If it fails in ordinary handling and the blow was not sufficient to break the coupler. I understand it is a car owner defect.

Chairman Schultz: That is right.

Mr. Trapnell: The case cited by Mr. Hall is a car that is built with steel draft sills running from body bolster to body bolster, and draft sill ends running from end sill to the body bolster and the lugs are riveted to these parts, and they form the draft sill of the car. Damage in conjunction with the end sill becomes under the rules in effect at the time this happens, a delivering line responsibility.

Mr. McMunn: In the case just referred to that would be a combination of defects under the present rules, but after October 1, 1913, it will be owner's responsibility.

RULE 47.

Mr. Zachritz: I would like to ask the opinion of members of this association as to whether they consider a driving screw as a screw for fastening running boards? In conversation with one of the interstate commerce inspectors he called my attention to a letter he received that said that a driving screw is not a screw; it is a nail and not comply with the law; that must be put on with a screw. As a matter of fact a driving screw is a better screw for the purpose. We found we could not pull them out, and we do find on new construction that a large per cent of the screws are broken off.

Mr. Stroke: My understanding is that you are not permitted to drive a lay screw, neither are you permitted to drive a screw or use a nail on a running board on safety appliances. You are supposed to have a flat head screw driven by a screwdriver, and while a drive screw is a screw in a sense, yet it is a nail when applied with a hammer.

RULE 60.

Mr. Zachritz: I would like to ask a question of the car foremen. I find in our work that a triple and cylinder is cleaned, and a month after the same cylinder is cleaned and the same date is shown on the cylinder. He did not stencil the cylinder according to the rule. Should not the man just cleaning give an offset? In some cases they claim they are doing the work according to M. C. B. rules. When a man fails to stencil it he is doing the owner an injustice, and if a car is cleaned the second time on account of the old date, the man who did the first cleaning should pay for it. You cannot get joint evidence. You have been charged twice for the same work by the same company and in some cases, at the same town by the same man, showing the old date both times. I maintain that unless it is shown that the brakes are inoperative that the man doing the second cleaning should be paid for the work and that the man who failed to stencil it should come across with an offset.

Mr. Stroke: I believe that the rules state plainly that a triple and cylinder when cleaned shall be stenciled with white paint and at the time and place the work is done. If a man has done this work at his point today and next week that car comes to my place and I find no stencil on the car, and that she does not operate, I believe if I take down that triple and cylinder I am doing the work as though I were cleaning it. I have to take it all apart. Am I going to do all this work and then have you bring an offset card to me for doing your work for you. I believe I am justified in billing for it. There are cases where the stenciling is not properly done. We are cleaning them within three days after they have been cleaned and find that they are very dirty. Stenciling a car does not clean it. In that case we have had bills returned because they have been cleaned and so billed but we found them dirty.

Chairman Schultz: The point is Mr. Zachritz would get two bills, one shortly after the other, satisfying himself that the original man did not do a good job. How can he make the first man who did the work reimburse him for the second cleaning?

Mr. Lynch: The stenciling may be obliterated and it is again necessary to clean the car. There might be a reasonable excuse.

Mr. Flannagan: This is a question I think should be decided by the company that billed and cannot be decided by any joint evidence. The arbitration committee have decided in previous cases that where a repair card does not show the information that you cannot bill for it; I should think the same rule would apply if it fails to show all the information on the stencil; that that bill would not be justified for the reason that the car owner is being charged twice on account of it being out of date. The arbitration decision that was mentioned does not apply, because you can clean a triple valve the following day if it is inoperative.

Mr. Hanson: We had a case come to our office along the same lines. The work was done by our men; we took it up with the air brake foreman, and he said the work was properly done, also that it was properly stenciled; the car owner came back and said that another company cleaned the car within two weeks after we had cleaned it. I said: "Cancel our bill." If we failed to stencil the car the next man had a perfect right to do the work.

RULE 68.

Mr. Boutet: Heretofore this body has always decided that if one wheel was slid flat 2½" and the mate wheel only 2" that one wheel would be condemnable but the other would not be cardable against the delivering line. The arbitration committee have seen fit to make the delivering line responsible for a pair of cast iron wheels when one is slid flat 2½".

Mr. Hall: There is more in that than Mr. Boutet mentions. The opposite wheel regardless of the size of the slid flat spot would be cardable.

Mr. Boutet: If the car has one slid flat wheel which is cast iron, slid flat 2½", not only one wheel was cardable but the pair.

Mr. Demint: You know the rule says the same responsibility to apply to the mate wheel. I think the rule is that you will allow the mate wheel to have 2½" spots.

Chairman Schultz: If the mate wheel has any spots in connection with the other, it is also carded with the original wheel.

Mr. McMunn: I think that that will work itself out when you get back to changes in prices. There is no price for a second-hand wheel. You have to apply a new wheel under all conditions to make a billable job. That was thoroughly discussed and it was felt that the mate wheel should be condemned whether or not there was a flat spot on it. When you condemn one wheel, you condemn them both.

Chairman Schultz: I understand it is immaterial when you get down to the billing, but as far as issuing a defect card for the mate wheel, it is not necessary. It is the intention to mention the mate wheel upon a defect card that has a spot.

Mr. Flannagan: Why should there be an exception made to the steel and steel tire wheel; why the 2 inches would not apply? I consider it just as dangerous, and I do not see why it would not apply to the steel tire.

RULE 86.

Mr. Zachritz: I would like to call the car foremen's attention to the abuse of the repair cards. Rules 68 to 86 inclusive. The rules specifically state that defects of wheels as given, shall require a repair card. I find a good many railroads are simply quoting the rule number, and if you want to you can go and hunt it up. I do not think it is justice to the car owner. They should not be required to hunt this information, and I think this association should require that repair cards be made out in accordance with the rules.

Mr. McVey: There is a question in regard to paragraph 5 of this rule. The arbitration committee stated that a bill could be obtained for wrong initials. We are getting bills back to our company for which we have no reference.

Mr. Stokes: I cannot understand how any member of this association is going to do anything towards eliminating the wrong numbers or initials. It is up to the foreman to get after the billing clerks and car repairers. The number and initial usually is plain on a car and there ought to be no mistake when they are copying it. If you leave it off of their bill it is their own fault.

Mr. Head: We have a great deal of trouble with our men. They will take the initials down on a card or piece of paper and go back of the shanty, or send it in to the office. They then look up the first name that will fit those initials and make out their card accordingly and that bill comes back. We try to impress upon our men the idea of writing the name in full and make the repairs and not go to the equipment register and try to find out the initials to meet it.

Mr. O'Donnell: We have trouble on defect cards. I think the time to check and verify is with the man who makes out the original defect card or repair card. I think it would pay to maintain what we would call a verification clerk and let him work up some kind of a method so as to bring the mistakes down to a minimum. I think it is a growing evil.

Mr. Livingston: We have sort of a double check. We have a work card that goes with every card, and before a bill is passed on to the superior office, we have a clerk check these repair bills with the work card. Wherever the fault is, he is going to locate it. It will not be with the clerk; it will be with the man who made out the repair card. I find that the responsibility is with the inspector, or the man who originally gets the car number and initial.

Mr. O'Donnell: I do not believe in relieving the clerks. The poor car inspector in the yards isn't the man to rub all the time. The agents in our district will take our car inspector's records in preference to the chalker's records.

RULE 105.

Mr. Flannagan: What consists manufactured articles?

Mr. McMunn: Anything that is shown in this schedule of prices.

Mr. Flannagan: That schedule of prices covers practically everything. Would you consider minor draft plugs manufactured articles?

Mr. McMunn: Yes.

Mr. Flannagan: The arbitration committee does not so consider them. It provides for a price per pound in that rule and must be charged at that price per pound.

Mr. McMunn: A Minor draft plug, if it does not go with a draft casting, is a malleable iron part.

Mr. Flannagan: That would not come under because there is a price fixed. That is the price for cast steel.

Mr. McMunn: But that would not cover a cast steel bolster.

Mr. Flannagan: Why should it cover a cast end sill?

Mr. McMunn: I am not prepared to say.

Mr. Flannagan: That is what I wanted to find out, if any member can enlighten me on it. I think it ought to cover patented articles.

Mr. McDonnell: That was the idea. Anything that has a set price that we have to purchase under a patent right. I am surprised that the arbitration gave that on that end sill.

Mr. Head: We have been charging a bolster at so much a pound and have been paid for it. I did not know that they were to be charged as manufactured articles.

Mr. Devaney: We consider anything that cannot be bought in the open market, as a manufactured article. Minor lugs cannot be bought in the open market. They are made about a mile and a half from St. Louis and I have to send up to Chicago and buy them. We charge the manufactured price; cast steel end sills the same, steel truck bolsters the same. The channel end sill we can buy in the open market; we do not consider it a manufactured article.

RULE 115.

Mr. Head: I presume we all have more or less trouble in trying to get trucks home for foreign cars destroyed; under the rule the freight charge is to be prepaid to destination. That caused a great deal of trouble on our road and it was finally put up to a decision. It went as far as the legal department and the rule has been changed to pay to the nearest connecting point. The rule is that there shall be absolutely no prepayment of any freight charges except to the intervening line, and the intervening line is entitled to local tariff rates and not a through rate. It has been the custom heretofore that a through rate would be obtained from the starting point to the delivering point, prepaying the intervening line, but the through rate would be obtained by the traffic department. Under the present rule, the arrangements hereafter, beginning October 1st, there will be no prepayment of any freight charges on trucks returned where there is a junction connection between the parties interested. But should the owner of the trucks live beyond the junction point, the intervening line shall be prepaid at their local tariff rates.

RULE 120.

Mr. Zachritz: If we have a car at a point where there is only joint inspection, we have a joint inspector and all the men working

at that point are joint men: Would the evidence of this joint inspector that this car was in that condition be sufficient to the owner or would we have to call in a disinterested man?

Chairman Schultz: Rule 12 covers that. The statement of the joint inspector would be final. We frequently use our office to make such inspection.

Mr. Flannagan: Do I understand that in moving the car you can send it home by any route that you wish irrespective of whether that car moved over that road down? Car service rule 3 provides that you can do that with the consent of the roads over which it has got to move, and it is going to take longer to get the car home than it did under the old system.

Chairman Schultz: I think the car service men will have a meeting and consider this. Under this present rule you cannot compel any car owner to take his car home direct. It says that it may be done, but we hope to get a rule by which it will be compulsory on the part of the car owner to ask that the car be sent home direct under freight charges. Under the present rule all he has to do is to send home route cards asking that the car be sent home via the route it moved, and it is my opinion they will correct this paragraph so as to carry out the idea. The question of being obliged to ask the intermediate line to handle a car for which they are going to be paid them is also wrong. If the car owner wishes to waive the responsibility or expense of moving the car home direct under our present rules he can do so.

Mr. Flannagan: I understand that a private car owner who has a car can way bill it home over any route. It does not say he has to send it home by the same route. He only elects to have it sent home.

Chairman Schultz: Under the system of handling private cars they pass them over the route that they have loaded mileage on. The idea was that rule 120 did not apply to the private car owner.

Mr. Forest: My understanding of this rule is that it is formulated for the express purpose as a benefit to the car foremen over the country in getting home cars that are in a worn out and bad condition. That is by redrafting the rule that they did it with the object in view of hurrying the car to the owner and preventing long hauls, and that the home route card would be furnished immediately upon demand.

Chairman Schultz: It is my understanding that immediately upon this joint inspection being held the per diem rate will stop.

Mr. McVey: The per diem rate ceases from the date of asking for home route card,—from the date of signing the home route card.

Mr. Devaney: Rule 120 is a step in the right direction. After the A. R. A. rule is fixed up, we still have No. 2 staring us in the face. Some will say it is a revenue bearing car and no one wants to hold it, and there will have to be something inserted there to show that there must be something to accept the car.

Chairman Schultz: You can compel the car owner to go to sufficient expense to make that car perfectly safe for anybody to handle in interchange at his expense. After he does that the car moves on regular billing. I do not think you will have any trouble. If any of us start these cars home in bad order it is our own fault. We have permission to make the owner put them in safe condition to get the car home.

Mr. Devaney: Suppose I fix it up to my satisfaction and the owner will say he does not want the car. Is there anything further you can do? You have to take it up with the owner again and get the other route.

Mr. Lynch: It seems to me that that would be a rather expensive matter. In the case of a car unsafe to load, due to age; it is in pretty bad shape and it may cost the owner of the car $50.00 more to get the car home. I would suggest that in modifying the rule, something be inserted that such cars would be destroyed.

Mr. O'Donnell: Let's try it a while and when we meet next year we will have something to talk about. I think the rule is going to work a great benefit in getting rid of these cars. Let us all co-operate and work together, and if there are any technicalities about it, overlook them. Track room in terminal yards is not to be had; it is at a premium. Let's pass a resolution here and send it to somebody so it will reach the master car builders and ask that home route cards be furnished more promptly. We are waiting for these 60 or 90 days.

I move you that a resolution be drawn up making it as strong as possible, that the organization here appeal to the master car builders, knowing the conditions as they do, that more prompt attention be given for the prompt disposition, sending the cars home or dismanteling them on the ground, as it suits the pleasure of the owner.

Motion seconded.

Mr. Boutet: I would offer as an amendment, that O'Donnell, Kipp and Zachritz draw it up.

The motion was unanimously carried and the committee appointed as suggested by Mr. Boutet.

Mr. Trapnell: I would like to make a report for the executive committee on the revision of the by-laws. After getting together this morning we have come to the conclusion that there is not time enough to formulate a set of by-laws suitable for this organization. Therefore we beg the pleasure of this association to grant one year's further time, so that at the next session we can come in with a set of by-laws that will be acceptable for the government and maintenance of this association. I move you that the extension of time be granted.

The motion was seconded and carried.

RULE 121.

Mr. Devaney: I do not understand what is meant. Is it originating point or delivering point?

Chairman Schultz: When the car reaches home.

Mr. Devaney: How would the third party get in touch with the joint inspectors?

Chairman Schultz: The road damaging the car asked for home route cards and the home route cards are supposed to pass the car home with delivering line defects, and upon the arrival home the car is supposed to be inspected by the car owner under Rule 120 and settlement made at that time at the home connection.

Mr. Lynch: How is the party damaging the car to be protected in case the car has any more damage on the intermediate line?

Mr. Burke: Doesn't that mean that a joint inspection be made by the company damaging the car and the company owning the car.

Chairman Schultz: I have run across this point, that the intermediate inspector at a junction point will stop a car having delivering line defects and moving home on home route cards. As I see it, home route cards covering delivering line defects are supposed to pass this car at intermediate points.

Mr. Lynch: The car might be damaged while under transit on intermediate lines; how is the party going to be protected who originally damaged the car?

Chairman Schultz: The only way I can see is that the home route card must specify as near as possible defects upon a car for which the road sending the car home is responsible.

Mr. Carr: We have a car now that was damaged in a wreck and it went 400 miles and it was held up and I have not been able to get a card.

Mr. McMunn: In case of a car seriously damaged and forwarded home, the owner shall arrange for a joint inspection and settlement shall be made directly with the car owner and the road damaging the car. If there is any damage accrued in the hauling of that car, it is a matter of settlement between the party hauling the car and the car owner, or the man to whom the car belongs looks to the man who forwarded the car to him, for anything that is due in the way of defect cards.

Mr. Lynch: The line delivering the car with the original damage, the line delivering the car to the owner, should be responsible to the owner for the additional damage.

Mr. O'Donnell: Suppose it is in Buffalo. We will take as an illustration that a steel Hocking Valley car is damaged on the Delaware rails, and the Delaware asked the Hocking Valley what to do with the car. They furnish him home route protection. The car goes to Cleveland and is offered to the Hocking Valley. You would have something on that car to show you without question that the intermediate line was in no way responsible to the owner, would you not?

C. Setzekorn (Am. Ref. Transit Co.): About 14 months ago we received an A. R. T. car from the Wabash, delivered to the Wabash from an eastern line. The car had been wrecked and temporary repairs made. Our inspector in St. Louis carded for all defects except running repairs. I got joint evidence, but I could not find the man that put in the sill bolster. I had another car that came in from the East; we made joint inspection to the car but we did not find a broken side plate. We called it to the attention of the joint inspector that we had missed the two plates; he said that he couldn't reopen and he cut out the side plates. I feel that if we take a car home under M. C. B. rules the joint inspection at St. Louis should be satisfactory to the party responsible that wrecked the car.

THURSDAY MORNING.

Mr. Boutet: Referring to Rule 120, it is our belief that this rule, as now applied, that with the joint inspection made, with two draft sills worn out and the end sill broken, or worn out or decayed, we have a right to demand from the owners authority to make these repairs: I have followed that since the first of the month, taken up 125 cases before I left and received a reply from about a dozen of them, and they gave authority to make the repairs when it was not in a worn out condition but the end sill was broken. I would like to know how that is in different parts of the country.

Chairman Schultz: We have made it a practice for the last two years, that when we discover a car with two worn out center sills and a broken end sill, we report to the owner and get permission to make repairs at his expense.

Mr. Boutet: We tried it before and sometimes they gave us the permission and sometimes they wouldn't.

Chairman Schultz: I do not understand that rule 120 has given us any more authority in that respect than the other rules did. We have always considered that was owner's defect, according to the rule. Just as soon as you break an end sill you have a combination which ordinarily would become a cardable defect in interchance. I take it up with the owner and ask for permission to make repairs to a broken end sill and worn out draw sills.

Mr. Stoll: In our city we have a practice since the arbitration decision that when a car is worn out and owners refuse to give authority, a joint inspection is made and the owner billed.

Mr. Lynch: I think that practice is general and the only advantage in the revised rule 120 is that the car owner has no alternative. He must give disposition of the car and send on home route cards or order destruction, and also short routing of the car.

Chairman Schultz: If a car requires repairs to two worn out center sills and broken end sill, invariably the owner will give us permission to make the repairs, and it is good practice to have the handling line make the repairs as soon as the inspection is made.

Mr. Kipp: There is one question in connection with rule 120 that I would like to find the sense of this association on. It seemed to be quite a general opinion yesterday that joint evidence signed by a joint inspector would be sufficient evidence to the owner that his car was in condition as stated by the joint evidence. I do not understand the rule that way. The owner isn't a disinterested person; it cannot be a disinterested party where two men or one man was representing a delivering and receiving line. He had a car in his possession and he wanted to do the best thing for the railroad he was representing; he was not representing the owner. We have a car at an intermediate point, and 25 miles from that point we have a joint inspector who is representing our company and representing the company that is making the joint evidence; they send down to that point for him to come up and make joint evidence. I do not consider that that is just the way this rule was meant to be understood.

Chairman Schultz: I would say in answer to that the chief interchange inspector can represent both lines as set forth in Rule 12. I do not think any statement prepared and signed by a chief interchange inspector will be questioned.

Mr. Kipp: That may be so, but should we interpret Rule 120 that way? Rule 12 is very plain that the joint inspector represents the delivering line and the receiving line, but he does not represent the owner of the car, a disinterested party that may be one thousand miles from that point. He is representing those roads right there and the car that he is making joint inspection on has no representative there. The man who is making that joint evidence is interested in both lines.

Mr. Elliott: I believe that Mr. Boutet has brought up an excellent point. The company I represent handles nothing but foreign cars and the case Mr. Boutet speaks of comes up every day. We get a car in with an end sill and two draft sills broken; we get a joint inspection, we write the owners to get permission to make the repairs at their expense. It is sometimes two months and I have known cases where we never got permission to make the repairs.

The per diem sometimes is more than the repairs are worth. So I believe that is a good point for a resolution where two inspectors representing disinterested lines could make an inspection and it would give the company that had the car in their possession authority to make repairs of that kind. I believe it would help the bad order condition of the cars.

Mr. Kipp: I do not understand that it is obligatory that the owner will give you authority. It is complimentary entirely. All we can do is to send it to the owner that the car is in a condition as stated, worn out and decayed; if he does not see fit to extend to us the authority for billing, it is all off; and as far as hauling a lot of bad order cars around that have broken end sills and center sills, I think any railroad is short-sighted to do that. Immediately proceed to make the repairs; if you get authority from the owner, bill it. If you don't, the car is on the way and you save the per diem.

Mr. Zachritz: If you do not get authority, bill him anyway, if you get joint evidence. Isn't it a fact that a chief joint inspector is supposed to be and is absolutely impartial. In Chicago if you represent two lines to sign a joint evidence with the Soo line that a car is in a certain condition, you are not a Soo line man, you are representing the other fellow. We have cases where I could not get a disinterested man short of 500 miles; are we going to be required to send a man 500 miles to take joint evidence on a car that you can repair any way from $30 to $50? Rule 120 provides that any repairs necessary, if you have this joint inspection, to put the car in safe and serviceable condition, the owner must pay for it. You are the judge. If there are two center sills and an end sill broken on account of decay, go ahead and splice the center sills and put in a new end sill and bill the owner.

Mr. Flannagan: It gives you authority to ask for home route cards. If you have a couple of center sills which are worn out and decayed end sill, the car owner doesn't have the privilege of giving authority to refuse it. He has authority to give you authority to repair it or destroy the car. If he refuses the authority, you can repair the car and you will undoubtedly win out. There was a case decided where one road asked for authority and the Co. refused to make the inspection and the road repaired the car and the arbitration committee sustained them in that action. The only trouble is on the per diem. If you order material for a car the per diem stops from the time you order the material. When a company notifies a car owner that a car is in a decayed condition, or a worn out condition which necessitates repairs to a combination of defects, which would be a combination, that a repair without authority or proper action should be that per diem would cease at that time; that we want now. Some roads will give it without question; other roads will take three or four months. If he won't make inspection you can produce evidence that the car is in the condition, you can repair the car and bill on him.

Mr. Zachritz: I move you that the president appoint Mr. Boutet as chairman of a committee, along with two others to report a resolution to this meeting that the arbitration committee be asked to recommend a change in this year's rules, waiving the per diem right from the date of asking authority to make the repairs on cars due to decay. Either that or allowing the repairing road to proceed with the repairs and settle it afterward.

Mr. Stoll: I would like to have that referred to the executive committee for their recommendation to the Master Car Builders.

Mr. Zachritz: If we go ahead and make the repairs, and we do not get authority to repair the car, but they do not want to put that much money in it; they want us to destroy the car. We write to them and explain the situation; tell them we put the car in first class condition and they give us authority to bill. But you are up against that proposition. In many cases they want to destroy the car. If you had a right to waive the per diem so that you would still make a little profit on the repairs you might be able to hold the car on the rear end of the repair track until you get authority, or until the case is settled, but if you have to pay a per diem, you are out money in the end.

Mr. Gainey: The association at Chicago presented to the arbitration committee the proper solution to get rid of these cars. It seems as though they have taken no action in it. I believe this body of men is big enough to present it right back to them and ask them to take a vote, yes or no, and put it into this book of rules. Mr. Schultz, chief joint car inspector, suggests eliminating end sills in a combination. He gives for a reason that it will permit railroads to make substantial repairs to cars on account of defects and combinations which require the attention of the car owner and secure authority to make repairs, which of course causes serious delay to the car. Then the Chicago men of the Car Foremen's Assn. suggested that the rules be made as it is that the delivering company be responsible, except where joint evidence is secured showing that the damage referred to in this rule was the result of decay, wear and tear, and such joint evidence to constitute authority for billing against the car owner. I do not think anything could be plainer than these two suggestions to the arbitration committee, and as I stated before, I think this organization is big enough to send it back to them.

Chairman Schultz: That question was given very serious consideration, and the committee resolutions are the results of very large investigation based also upon the experience we have personally had in operating the Chicago Interchange Bureau for about a year previous to the formation of that recommendation, and we were very much disappointed in not having it adopted. If the members of this convention could get that resolution before the arbitration committee asking that the recommendation of the Chicago Car Foremen's Association, granting authority to make repairs upon inspection, it would be very desirable, and I would entertain a motion, which includes the same object.

Mr. Zachritz: I change my motion to read that way.

Mr. Pierce: I would like to give a suggestion. Several of the roads are getting down to the lowest minimum for costs and expenses. I would like to suggest that when this request is made upon a car owner for permission to make repairs to this car, that the per diem stop at the very time the request is made out; then you have information from the car owner whether to destroy the car or make repairs.

Chairman Schultz: They have given that very thing in Rule 120, but the question before the house is a car that is not a proper subject for Rule 120, but is a better car and has worn out center sills and broken end sill, owner's defect.

Mr. Pierce: Why should we have to pay per diem on that car. It should stop at the time we make request.

Chairman Schultz: This resolution goes further than you anticipate. It includes that the inspector gives immediate authority to the handling line to make the repairs and the only per diem would be during the time that the car was undergoing repairs, which would be only one or two days. The resolution means that when a car is discovered in this condition that the joint inspection authorizes the delivering line who makes the repairs.

Mr. Carr: As I understand it the car department has nothing to do with the per diem. When we make request for home route cars, if the request is properly given, if we have center sills, broken, decayed and worn out—three conditions. We may get a box car with a center sill worn out and broken, but I do not think we get very many that are decayed. You get a gondola car with a center sill decayed and worn out and broken; you get the intermediate sill broken, but you do not get them decayed in a box car. If it were a question of settling the defects as existing, I do not think there would be much question. If you have center sills broken and an end sill broken, you have a combination of defects. I ask you how many center sills you find in box cars that are decayed.

Mr. Elliott: We want a resolution that will give us power to repair these cars on sight and make a joint inspection.

Mr. Flannagan: I will make a motion that this association refer to the Executive Committee of the Master Car Builders' Association that the proposed difference or change as read by Mr. Gainey from the Chicago Car Inspector's Association be adopted.

Seconded and carried.

The chair appointed Mr. Boutet, Mr. Flannagan and Mr. O'Donnell on the committee to draft a resolution to that effect.

Mr. Zachritz: We find that the chief joint inspection points have a habit of issuing defect cards—corner of roof broken A right; as a matter of fact we find that these defects are on the left side of the car as far as they apply to Rule 14; that is, on the left hand side of the car as you face the B end of the car. Again we will find some damage to the sheathing or roofing on A L, which is on the right hand side of the car as far as Rule 14 is concerned. Some claim that the right side of the car facing B end is the right hand side for all purposes. Some claim that where it is designated as A R it is the right hand facing A end of the car. I would like to get an expression. Sometimes we have bills returned for that very thing, because they are billed on the left side of the car when in fact they claim it is on the right. We have to take it up with each road and learn their practice.

Chairman Schultz: In the recommendation to the arbitration committee this year we submitted a cut in which we attempted to ge a diagram in the M. C. B. rules showing the ends of cars for the guidance of the car inspectors, and it was turned down by the arbitration committee. Rule 14 designates the location of oil boxes and their contained parts, but it has nothing to do with locating the damage upon the body of the car. Therefore, it was my idea that in facing B end of car that all the damage to the body on the right side would be as far as the side door, B R. And on the left side as far as the side door would be B L. And then continuing to the A end of car, and facing the car, all damage to the A end of car would be A R and upon the left side A L. And in making inquiry amongst my car inspectors, I find it was their general understanding, and has been so for twenty years.

Mr. Demint: If we can designate the oil boxes, why not the sides of the cars. I cannot see any reason why we should consider four sides. If you say A R and A L you have four sides of the car.

Chairman Schultz: I want to explain one example; a car inspector interchange would take a record of five side boards and not sufficiently damaged to warrant carding. You take the car out and damage it in service, five side boards on the same side of the car but on the other end. They are cardable defects. They might say you carded a damage that is not cardable on account of not having a sufficient understanding of the rule. When I inspected cars such an idea never occurred to me in regard to the body. The M. C. B. Assn. have given us a rule to determine damage to oil boxes, etc., but not to body.

Mr. Maupin: I believe in some parts of the country there is a pass card applied. There seems to be a great deal of confusion with car men at different points as they claim they have received their pass cards and the case became cardable at his point. There would be no confusion if they would put a pass card on there.

Chairman Schultz: In the city of Chicago, for the purpose of living up to Rule 3 as closely as we can, and in order to give the receiving roads and inspector the benefit of the other inspector's opinion, we put out a pass card which is strictly for the information of the men in Chicago. If any of them get outside of Chicago you better tear them up for they are no good.

Mr. O'Donnell: I think we are wrong in putting on a notation card. It should be a defect card or nothing. The opinion of one inspector should be as good as any other. These notion pass cards are getting us in trouble. If Mr. Schultz would card everything that the M. C. B. rules tell us to card, it would clear the atmosphere and we would know where we are at. We are doing that in Buffalo and it has the approval of our executive committee. A car inspector should know absolutely whether it is cardable or not.

Mr. Lynch: In regard to the pass card at Chicago. The object, as I understand it, is to get a uniform practice among the inspectors. It is a very good idea but I would suggest when cars are moving out of Chicago that you instruct them to remove these cards.

Mr. O'Donnell: I am requested on behalf of the ladies who are present with us in the city of Minneapolis to extend to the entertainment committee in particular, and including the people of Minneapolis, Mr. Campbell and the others, to thank them for the excellent entertainment that has been given them during their stay. I think it would be unnecessary at this time on account of the lack of time to dwell too much on what the ladies want to extend to the entertainment committee, and it is a genuine pleasure on my part to carry this to the entertainment committee on behalf of the good ladies and tell them that when they go back to their homes the convention at Minneapolis will remain a pleasant memory in their minds while they go about their work, and the entertainment committee will be foremost in their minds.

Mr. Boutet: I move that the remarks in behalf of the ladies be accepted by this association and printed in the proceedings.

Chairman Schultz: For the past two weeks I made it my business to go out in the yards and check up lading and I am safe in saying that less than 10 per cent of all the loads on open cars are loaded strictly in accordance with this book of rules. I went to the large concerns in Chicago and they said: "You are the fellow we want to see; you come here to tell us and insist upon us loading cars according to your rules; I will take you into the yard and show you 25 cars that come from the South that are not loaded properly." The question of loading is very much neglected throughout this country. In Chicago on April 1st, we put car service rule 15 into effect. It never had been in effect before. We were very much surprised to find conditions as bad as they were. In going into the situation we found that cars were being adjusted and transferred very frequently and a transfer order issued, and when we dug into the matter we found 90 per cent moving in Chicago were not properly loaded. The enforcement of the rule in Chicago resulted in all business going out from Chicago was being loaded properly. I hope to get an expression in this convention from all parts of the United States by which we would all get down to business and eliminate as much as possible the improper loading of loads on open cars. In Chicago in each case where a car is held up for transfer or readjustment of load we fill out a form, and would suggest that it be shown in the minutes.

On receipt of this information in my office I issue a transfer order in addition to that: I send one copy of this blank to the general manager of the road on whose line the car was improperly loaded; he takes it up with his car foreman and agent at the point where the wrong loading was done with a view of preventing the wrong loading of any more cars. We have been getting some excellent results from some places where they never loaded a car right. It was also my experience that where I went to the man in charge of the loading I did not get a very good reception, but where I went to the head of the institution and told them that it was expensive to load a car improperly, he readily agreed to it. I suggest that some steps be taken to bring about these results.

Mr. Eyman: I wish to say that our company ordered enough of these rules for loading materials and are giving them to the various industries for loads of this character, and also we offer assistance to teach them how.

Chairman Schultz: I find this book of loading rules is far more important than the M. C. B. rules ever were and less people understand it. Some of the railroads pay no attention to getting this rule in the hands of their car inspectors and see that they are understood and carried out.

Mr. Hall: In regard to transfers in Chicago, do the inspectors make an inspection of the interior of box cars in regard to lumber. We have two or three cases where our line has been carded for improperly loading lumber in a box car.

Chairman Schultz: Short pieces of lumber are shifted out of the side door.

Mr. Hall: You mean where the side door is bulged out by the load and it is necessary to go in?

Chairman Schultz: Yes, that is it.

Mr. Maupin: We are possibly situated differently in St. Louis in regard to handling cars; when we turn a car down on account of improper load, it does not make a particle of difference who they give it to, they cannot get it off of the terminal rails. So we are placed in a better position in that respect than at other points. When we turn a car down, or refuse to accept it and when it is not loaded in compliance with the rules, the car will stand there. They tell us the same thing that they know their business and that the cars are loaded right and that cars are loaded that way on other lines. We tell them if they violate the rules at other points we do not care, but we are held responsible for the proper loading of cars, and we do not care how long they have been in business, they will load in accordance with the rules or we will not move the car.

Chairman Schultz: I know of superintendents who issue instructions saying: "We had you book of M. C. B. rules and call your attention to the fact that all shipments of goods by you must be loaded in accordance with the rules. If you fail to do so, and this company is put to any expense in readjusting, we will expect you to pay for it; otherwise such cars will be returned to your plant for readjustment or loading and you will be charged for switching and any per diem." That does the business every time.

Mr. Hitch: I think the form you just read that you are using in Chicago will have a tendency to bring about good results throughout the country, providing other roads take it up as you have.

Mr. O'Donnell: I think Mr. Schultz' idea is an excellent one, and I want to supplement the remarks by the information that all of our officers held a meeting and went over the situation of bad loads in closed cars, box cars. They submitted there a large number of photographs showing the condition of loads as they went into the transfer platform for readjustment, and the whole trouble is due to no cooperage at the door way. They force the doors out and on double track lines you can readily appreciate the danger. I understand from Mr. Thompson that the American Railway Association has been giving this attention, and to my personal knowledge they have asked for a number of additional copies from our association, showing with this canvas that they are trying to better conditions all over the country there isn't any reason why the side door question of box cars, and the open cars of lumber and double loads should not be improved. We have in the neighborhood of some 6,000 orders every month for bad loads. They average $1.00 per car; that is a large amount of money for the delivering line to pay. I think it should work back to the person who is actually responsible for putting the load in the car, not the intermediate or delivering line. I think the larger officials should be appealed to at all these interchange points on the basis of giving them the information as to just how it should be run.

Chairman Schultz: I compiled some data for four months of the business handled through Chicago, and was very negligent in not bringing it up here. It shows a deplorable condition. It shows that the large traffic line that is liberal gets badly soaked when the car comes back. They complained on account of the large number of transfers but when I went out to see them I found out that 99% were justified. The long haul lines transfer for worn out draft sills with short draft timbers for the reason that they are all worn out. The bolt holes are worn oblong and it takes no strain to pull out the draft timbers. If they let them go down the line the agent loads them for 200 miles and about that time they get a return load. It also shows a bad condition in the South in the way of loading yellow pine lumber, and the roads that carry that lumber are very much penalized. It also existed as to the shipments of flour in the large milling points in the way of absence of door protection. By the time it reaches Chicago the contents will come in contact with the door, and they will be opened up and properly reloaded at delivering line's expense. I am glad to see that that has been practically eliminated. The road that is careless gets penalized for it.

Mr. Trapnell: As I understand A. R. A. Rule 15 the association has omitted the rule as published in this new book of ours. The present rule in this book is the same as in the old book, while the amendment to the rule is the delivering line shall pay the cost of transfer when the car cannot be repaired under load. This says when the car isn't safe to run under M. C. B. rules.

Chairman Schultz: A. R. A. rule has been amended as Mr. Trapnell says, but the M. C. B. Assn. did not feel that it was a proper move and did not put it in the M. C. B. rules. They thought it would have a tendency to encourage the loading of bad order cars. They held that most any car could be repaired under load, with the exception perhaps of certain cars whose contents would be damaged. I am somewhat familiar with what prompted the A. R. A. people to modify their rules. It was an arbitration decision which granted a Colorado line permission to transfer in place of changing wheels, or welding of arch bars. Unless you have a special agreement you can transfer any car that wants any repairs and make the delivering line pay for it. It would seem from the modification as made by the A. R. A. that it was not quite what we should have, but something in between what we got and what they recommended seems to be necessary. In the case in question which is No. 913 the D. & R. G. transferred against the Colorado & Midland a car with an arch far broken. Technically speaking, I feel, under A. R. A. rule 15, without any modification you can compel the delivering line to give you a transfer order, if you wish, for any defects upon the car that requires repair before it can be safely forwarded.

Mr. Zachritz: We have an arbitration decision where they define the object of Rule 2, that is that we shall not offer any cars that were in defective condition at their last inspection.

This opens up the question. Where they offered these cars that were in a defective condition when they offered them, that the defects did not arise between the two inspection points. Can you not refuse the cars when loaded in that shape according to that decision?

Mr. Wheal: This brings the point to my mind in regard to the third paragraph of Rule 2: Cars loaded in interchange must be accepted with the following exceptions. When it comes to paragraphs C. D. and E. they conflict with A. R. A. rule, and we are accepting cars improperly loaded and billing according to A. R. A. rule 2, which I claim is contrary to M. C. B. rule which is that they be held on the delivering line for transfer.

Mr. Anderson: We have a point on our line that has been giving our people loaded cars in a broken condition. I called on the master mechanic and asked him how far his understanding was of the repairs. He says: "We will give you loaded cars under rule 2." We are transferring under protest. As I understand it the rule has not been accepted by the mechanical department and it is not in force other than it was before which gives the privilege to transfer for anything in the judgment of the receiving line.

Chairman Schultz: Your people are members of the Master Car Builders' Association; they have accepted this rule. If you work against them you have modified the rule.

Mr. O'Donnell: Isn't it a fact that there should be some method of education where you charge a delivering line for transfer, as to how far you should go on repairs? You are liable to charge the delivering line for transfer where the repairs could easily be made with a little common sense. Where we cannot get inside of a car for draft bolts, we allow orders; for a special type of metal bolster, we allow orders. Our transfers run about one out of every 300 loads. We have on an average of 1,200 transfers with the 13 roads. The east bound interchange is about 60 per cent loads. I should say the interchange runs about 80 and 20. The east bound is heavy and the west bound is empty returning. The west bound is all hard coal, etc., but the expense runs on the stuff going to the seaboard, and I really think that the only way you can arrive at just what you should repair and what you should not repair is by having some method of education. At isolated points you have to repair them. We have a large force of men employed and the operating department would prefer to transfer a load rather than hold it and attempt to repair it.

Chairman Schultz: In Chicago we have adopted it practically as the A. R. A. rule reads, but with repairs that can be made by shifting the load under Rule 107, we expect them to make the repairs, if the car is otherwise a good car.

Mr. Wheal: I do not think either one of you are living up to the M. C. B. rules. It specifies what can be repaired under load and what cannot. It must be something that M. C. B. rules could not allow you to repair under load.

Mr. Elliott: We tried the one sill and everything, and we got back to where we started, where we could not get a transfer unless there was a combination of defects.

Mr. Singer: We transfer for the delivering line only, provided the repairs cannot be made in 24 hours.

Mr. Ubanks: We have always adopted a reasonable method of transfer. We transfer wherever it is necessary. If we have a load of bulk corn with all the draft timber bolts broken, we have got to take at least half of the corn out of the car to put in the bolts. Where we transfer these cars we issue a transfer card; we do likewise with broken metal truck bolster and other parts of cars that we cannot get hold of in the open market to make repairs.

Mr. Hall: I am working under the association rules at St. Louis. At St. Louis you have to have a combination of defects before you can get a transfer. We accept cars in St. Louis delivered to Kansas City or Peoria, or some other point where they have the amendment to A. R. A. rule 15, on putting on the 24 hour clause. We have got to accept the car at St. Louis. If we find that it has two broken draft sills we have to transfer at our own expense. We cannot get anything for it, but if it gets away from us and goes to the other

Form 18

(TO BE MADE IN TRIPLICATE)

THE CHICAGO CAR INTERCHANGE BUREAU

409 GRAND CENTRAL STATION

(Station)_____191__

MR. F. C. SCHULTZ,
CHIEF INTERCHANGE INSPECTOR,
409 Grand Central Station, Chicago.

Kindly furnish authority for transfer or adjustment of lading for

INITIAL	NUMBER	CLASS

Loaded with_____

Moving on_____Ry. Way-bill No._____Dated_____

Billed from_____to_____

Consignor_____Consignee_____

Routed via_____Was delivered by_____Ry.

to_____Ry. Via_____Ry. on_____191

Was transferred into_____(INITIAL) Car_____(NUMBER) at_____(STATION) on_____191

By_____Ry. on account of the following defects:

_____

_____

_____

Or lading was adjusted account car being improperly loaded as follows:

CAUSE OF ADJUSTMENT	ADJUSTED AS PER RULE_____PAGE_____

Was car originally improperly loaded?_____

Shipment delayed_____hours, due to the load not being properly loaded.

The above repairs or adjustment of lading were made at this station by_____Ry.

_____FOREMAN

_____RAILWAY

fellow and we haul it over our lines, then we are stuck for the cost of the transfer. We do not only have to pay for the transfer but we have got to accept the car back again empty and repair, and make ourselves liable for a combination, or something of that sort if we do not repair, and pay a per diem on the car. I do not see where our revenue is coming in if we handle the car.

Mr. Elliott: Mr. Hall says he cannot get a transfer in St. Louis unless he had a combination of defects, so he runs the car. Just because somebody will give you a transfer order for one sill broken, does it look like good business to transfer.

Mr. Hall: Are all interchange points going to work in accordance with A. R. A. Rule 15, or are we going to penalize for transfers, or are we going to make an amendment and put in the 24 hour clause?

Mr. Schultz: It is very desirable that all the arrangements at these large terminals should be exactly the same. I think that we should have a uniform transfer rule.

Mr. Demint: I do not think it is against the M. C. B. rules to have a special agreement. As you will notice rule 15 says unless otherwise agreed. We have a 24 hour clause in our working agreement, and so far it has worked out perfectly satisfactory, and I am inclined to believe that every other interchange point should have the same clause.

Mr. Boutet: The only difference I can see in the rules of transfer, is at St. Louis you must have a combination of defects before they give a transfer order. I do not believe it is fair to be compelled to receive a car and transfer it at the expense of the receiving line and then haul the car to some other large interchange point and again be compelled to transfer under other conditions. I believe the rules should be uniform at all large interchange points to avoid working a hardship.

Mr. Ferver: I think we are arguing on a matter that is entirely out of order. We have a book of rules to go by. I claim we are violating the rule. I believe that a car with a center sill broken off is not safe to place in a train. If a car cannot be repaired on the road it will be transferred to the nearest repair track.

Mr. Flannagan read the report of the committee as follows:

Resolved: That this association in annual meeting assembled, do hereby petition the arbitration committee of the M. C. B. association to request the executive committee of said association, to provide in the M. B. C. rules of interchange, preferably under rule 120, the following recommendation:

"If a car is found to have decayed or worn out parts which constitute an unfair usage combination under rules 37 to 42 inclusive, if repairs are made without authority from the car owner, a joint evidence statement shall be furnished stating the actual condition of the car in accordance with rule No. 12, and this statement will be authority for the company having such car in its possession to make the necessary repairs and bill car owner for the cost of the repairs, providing said repairs are necessary on account of defects due to ordinary wear and tear. The joint statement to accompany repair cards as authority for bill."

This request is made in order to facilitate the prompt repairing of bad order cars, and to place the responsibility for these repairs where it properly belongs. Under the present rules and decisions, the company having such car in its possession must write the car owner for authority to repair before any repairs are made, and this action results in seriously delaying bad order cars, and also burdens the company handling the car with per diem charges which frequently amount to more than the cost of repairing the car. The car owner is therefore in no hurry either to inspect the car or to give authority for the repairs, and this works a direct hardship upon the handling line, besides blocking repair tracks and yards. Committee: H. BOUTET, H. FLANNAGAN, T. J. O'DONNELL.

On motion duly passed the resolutions were adopted.

Mr. O'Donnell read resolution in regard to Rules 120 and 121 as follows:

Resolved, That this association in annual meeting assembled do hereby present to the Master Car Builders' Association the following resolution with respect to Rules 120 and 121.

That the Master Car Builders' Association, through their respective officers be appealed to to take up without delay the importance of all roads throughout the country giving their immediate attention to requests for home route cards or for authority for dismantling cars, as it is found that such home cards, or authority for dismantling is being unduly delayed. This taken in conjunction with lack of proper storage room is working seriously to the disadvantage of handling lines, and it is felt the above action is most desirable for the successful operation of the rules.

Attention is also called to the fact that in some cases when cars reach owner's line they are not repaired permanently, and it is respectfully recommended that owners give proper attention to such cars, rather than permit them to again leave the home line with the same defects in existence. Committee: A. KIPP, G. P. ZACHRITZ, T. J. O'DONNELL.

On motion duly passed the resolution was adopted.

Mr. Lynch: With your permission, I would like to refer to Rule 59, to that part of it which reads "broken pipe or pipe fittings on account of insecure fastenings," I would like to get an expression of opinion, if cars are being handled in the yards with the air hose coupled up and in switching they part the car, if that would be considered fair or unfair usage. Suppose that they break that.

Mr. Boutet: There is a decision which says that the air hose was improper or the pipe would not break.

Mr. Lynch: In the same case, if you pull a hose off, it is owner's responsibility; why should you not continue that to the pipe and call it owner's responsibility the same as the hose.

Mr. O'Donnell: I think very few cards should be given. I think the owner will accept the charge in most every case.

Mr. Lynch: I want a fair report. If it has been broken by uncoupling the hose and applying, of course part of the pipe comes out; that isn't a split pipe. Why not call it a broken pipe?

Mr. Burke: I find pipe broken similar to Mr. Lynch through the shifting. We always bill the car owner, and do not have any trouble collecting.

Mr. Thomas: I think Mr. Lynch is trying to get at unfair usage of broken pipe, but in regard to the hose, there is an arbitration decision which says it could be done in fair usage because the hose are made to couple automatically, and if they won't, it is owner's defect. I think the pipe breaking ought to be also owner's defect.

Mr. Hyman: In discussion with the individual members of the association. I find that there is considerable interest in regard to the committee that has been appointed to apply to the Master Car Builders' Association in regard to doing away with the low capacity cars. Perhaps we all have our own opinion in regard to the different conditions that we are in. I think that this association is in touch with these things and can give a great deal of assistance toward that idea. I think if you will keep tab on the cars that come on the repair track,—and keep track of the capacity of these cars, you will find that the low capacity cars are the ones that are giving the most trouble. I would like to have a little discussion on it and see if we cannot help the matter along. They have only gone as high as the 40,000 and 50,000 cars in the recommendation, but I think a great many are making them apply to the 60,000. I believe that it is a far reaching situation and it ought to be given due consideration.

Mr. Berg: I believe the bad order situation is general throughout the country in spite of all the wise and liberal modifications of the rules the improvements in construction made and recommended by the M. C. B. still leaves us with a large number of bad order cars that taxes our repair facilities and necessitates employing every available contract shop. The situation prompts me to quote a portion of President Buker's address at the 40th annual Master Car Builders' convention in 1906. In referring to the enormous increased tractive power and its affects in buffing and pulling shocks, he said: "I also wish to impress upon your minds the necessity of having brought to the attention of the management of your respective employing companies, through the proper channels, full information in respect to damage and destruction of freight equipment by means entirely beyond the control of mechanical department officers, and against the effects of which engineering skill, scientific research, practical experience, modern design, or excellence of materials affords, neither protection nor relief, this being controlled only by the transportation branch of the operating department." These remarks are more applicable today than at the time spoken, but as the large locomotives are here to stay and the number of cars per train not likely to be reduced, it is up to us to cope with the present conditions, all that are not able to on account of lack of facilities realize that they will have to prepare for necessary shops and repair branches, and it is the duty of every foreman to endeavor to put his cars in the best possible condition when they are in for repairs. The application of new draft timbers on split center sills and hiding a damaged or decayed end sill with a new head block or to try to secure decayed end and side posts by the application of new sheathing is as bad a practice and as expensive and ineffective as to nail on a new end fascia to secure a loose roof. Wherever this is practiced it should be vigorously discouraged. The most substantial constructed cars fail under the treatment they are subjected to. Makeshift repairs only result in frequent repair track movement. None but the very strongest equipment stands the service. The slogan seems to be when signaling, the enginemen come back on them, there are no windows in these fellows back here. And in this connection I would ask you all to be fair on receipt of your equipment, home. The recent ruling of the M. C. B. Association to get worn out cars home should have a beneficial effect on the crippled car situation, if we do not resort to technicality, and cause undue disputes over defects that occurred in what we term fair usage or are the results of faulty construction. Limit patching up cars to points where you are unable to do otherwise.

Write up unserviceable cars and get them home empty; do not load them only to be held up at first interchange, and cause your chief interchange inspector or arbitrator to spend so much of his time endeavoring to dispose of loaded cars that were plainly unfit for service when placed for loading.

Mr. Boutet: I move that Mr. Berg's remarks be accepted and made a part of the proceedings of this association, and when we go home that we will live up to the suggestions contained therein. Seconded and carried.

Mr. Zachritz: I would like to call attention to the fact that this association is not the owner of a set of the arbitration decisions. I suggest that the secretary secure them for each convention and that they be distributed to us.

Seconded and carried.

President Stark: I move that the resolutions of the death of Mr. Bradley be adopted; that the same be made a part of the minutes of the session, and a copy be forwarded to the family of the deceased. Carried.

Joseph A. Bradley.

Whereas, The membership of the Chief Interchange Inspectors and Car Foremen in convention have learned with deep regret of the sudden taking off of our fellow member and worker, J. A. Bradley, while in the performance of his duty.

Whereas, We, as Christians, having full confidence in the wisdom of the Divine Master, who doth all things for the best, and we bow in humble submission to His will.

Be It Resolved, That the membership, including the ladies, who are at this convention, do extend our most heartfelt sympathy to Mrs. Bradley and children upon the loss of a good husband and father and fully realize the good work that our brother has done for the association for many years past.

Be It Further Resolved, That a copy of these resolutions be printed in our minutes, in the *Railway Master Mechanic*, and a copy sent to the family of the deceased. Committee: A. BERG, C. J. STROKE, T. J. O'DONNELL.

Mr. O'Donnell: It has always been customary on the death of a member to say a word or two and I would like that privilege. To those of us who are assembled here—many of us were acquainted with Mr. Bradley, and I think we all agree that his soul and heart was in this convention from year to year and with his family. I think his untimely taking off is a distinct loss. I had the pleasure of knowing Mr. Bradley upwards of twenty-five years. I have been intimately acquainted with him for the last thirteen years in my position, and I will say that in all of Mr. Bradley's dealings with the arbitration department, we never seemed to disagree when we parted. Mr. Bradley had the faculty of parting with friends in a friendly way, and I think it is the sentiment of the convention here that Mr. Bradley must be better off in being taken as he was, as his time had come. I thank you for saying these few words in memory of Mr. Bradley.

President Stark then introduced Mr. Owen W. Middleton, Editor of the *Railway Master Mechanic*, who spoke as follows:

Out in the lobby Mr. Stark said the association would like to have me say a few words. I told him I was no speaker, but that I was going to take advantage of the privilege. I believe this association has a great many things to be congratulated upon. In the first place, they are to be congratulated for the officers they have had this year. I want to say that I have come in contact with all of them. Mr. Stark, Mr. Skidmore, Mr. Boutet, Mr. Trapnell, and others, and they have shown a great interest in pushing the welfare of this association. I know Mr. Stark particularly has kept me informed as to all the developments that have taken place in the association. That is something we appreciate a good deal, because we have in a large measure to dig these things out for ourselves.

I think the association should feel proud of the way in which its name is mentioned in the last report of the Master Car Builders' Association in connection with the arbitration committee where it says that this "was recommended by the Chief Interchange Car Inspectors & Car Foremen's Association."

Another thing that the association should be congratulated on is the attendance at this meeting. I am sorry that I did not get here for the first two days of the meeting, but I was talking with Mr. Skidmore today and he said there were 160 members registered, exclusive of the ladies. The association has a membership of over 300, and that certainly is a very good percentage. It is a larger percentage of attendance than there was at the Master Car Builders—that is, of active members. I have attended the meetings of this association for a number of years and I do not think that there is an association where each member is so willing and anxious to get up and talk. I have been to some associations, and I will say that there are some, where the discussion has to be forced. I never saw an instance where it had to be forced at this meeting. I am glad to be with you and thank you for this opportunity.

Mr. Devaney: While the railway supply men are here I wonder if I can get a list of all the prominent metal brake beams in this country. We have a number of brake beams failing and if there is any one present who can help me I would like to have him do so before we adjourn; so that I may be able to order the different parts.

President Stark: We have with us Mr. Thayer of the *Railway Age Gazette* and would like to hear from him.

Mr. Thayer: You have taken me unawares. I did not realize that I was to be called upon to say a few words here, but I want to tell you that I have enjoyed the convention very much. This is my first meeting with you and I want to say that you are a live association. You certainly get into the work in great shape and show a deep interest in all interchange rules. It surely is the right place to get information and a correct interpretation, as you must get it. It has been clearly brought out that there is some misunderstanding and these meetings are the place where these misunderstandings should be taken up. I want to congratulate you on your work and your very successful meeting.

Report of Committee on Resolutions.

Mr. O'Donnell: Your committee on resolutions ask your permission to report as follows:

That the thanks of this association be and are largely given to E. R. Campbell and his associate car workers of the city of Minneapolis, also to Mr. Zachritz for the flowers and nice red apples; to the good ladies of Minneapolis for their untiring and courteous efforts to make the stay of our ladies pleasant and cheerful; to His Honor, Mayor Nye, for his presence at our opening session and his remarks as to taking care of us during our stay; to the Rev. Dr. Lawton for the opening prayer and blessing at our opening; to Mr. Lake, General Superintendent of the M. & St. L. R. R. and his associate officials for the many courtesies extended and the train service; to Mr. Gillman and the officials of the Northern Pacific for the same service; to Mr. Foster, the General Superintendent of the C., M. & St. P.. for the same service furnished on transportation; to Mr. T. H. Goodnow for the excellent and encouraging remarks given to the members on their duties as to the up-keep of the equipment; to the management of the West Hotel and its employes for the very courteous treatment given us in our stay. We have received nothing but kind words and offers to put themselves out to make our trip here most agreeable. We hope the same may be said when we pay our bills. To the press of Minneapolis, especially the *Tribune,* for the complimentary remarks made on the opening of the convention as to the elopement and many other subjects; to our stenographer, Miss Unkenholz, for her perennial smile; to the many firms contributing toward our entertainment, and last but not least, to our excellent entertainment committee, our beloved Mr. Wright who heads the committee, and Mr. Schlacks, the treasurer—I think he should be especially mentioned for the untiring work toward making our stay most pleasant,—Mr. Webb, Mr. Derby, Mr. Tawse and Mr. Cook, and many others are to be commended for the hard work and energy they have given us. Words cannot express our thanks. Mr. Wright, of course, has been with us many years, and yesterday he told me that next year it would not only be Mr. Wright but Mr. and Mrs. Wright. Anything we may say will not express our feelings toward you. May you have good health and many years of happiness in the future.

To the officers of this convention I know the delegates are most thankful. Mr. Stark has taken up a new field of labor, and I know it is the wish of every one that he may have the best of luck in his future position. Mr. Schultz, our vice-president, has treated us kindly during the session and the other officers, including the secretary, have done their best. Outside of this your chairman has nothing to report, only to say, safe home to your families, and may we all meet again in 1914. (Applause.)

It was moved that the report be received and acted upon by a standing vote of the association. Carried unanimously.

Mr. Wright: I am not at this time going to attempt to express myself for the sentiments of the committee in showing the appreciation. The feeling of appreciation that has been shown for our efforts during the short stay is all this committee asks. It has been requested that those who attended this convention and contributed to the entertainment that we were able to give should be known to this body, and for that reason I am going to read the names of those who contributed and helped us in the entertainment.

Election of Officers.

President Stark: The constitution and by-laws make ecrtain provisions with reference to the office of president. I think it will be well for a motion to be made with reference to the filling of the position of President.

Mr. Boutet: At the Detroit meeting a resolution was passed by this association that the president should hold his office for one year, and the vice-president should succeed him without any action of the session, but I would move you that Mr. F. S. Schultz be elected unanimously.

Seconded by many and carried unanimously.

Mr. Boutet: I recognize in the audience quite a number of new members who do not perhaps realize the strenuous time that this association has had. I want it understood that my term as executive member expires this year, and under no consideration will I accept any office from this body. I believe I have had all the honor that it is possible for this association to bestow on any person.

I believe that I have done my duty as a member and officer in trying to upbuild this association, and I do not see any benefit in having me sit in office any longer, but I will continue as long as I am able to give help and expect to work for the association at all times as occasion may demand. It has caused me a great deal of feeling to get out of the harness.

Be careful whom you elect as your officers. You have an excellent set of officers who have worked and striven to help this association. They have all done their duty, and I trust that in looking for officers that you are going to elect, look to people not as individuals but what is best for the association.

If you will continue to do this you will have an association that you will not be ashamed of. You have grown to national importance and I trust that you will elect men who will have the up-building of the association at heart and let your individuality drop.

President Stark: I am sure we all appreciate what our friend has done. Mr. Boutet has given a lot of hard work during the past 13 or 14 years toward the up-building of this association, and as he has intimated today, we are not struggling along as a child but we are full grown. I am proud of the association as it exists today. It has a great future and I am sure that with the hearty co-operation of the individual members we can continue to grow in usefulness. I want to personally thank Mr. Boutet for the assistance he has always given me. I am glad he takes this wide open stand. Let us think first and only of the association.

The next will be election of a vice-president.

The name of F. H. Hanson was placed in nomination for vice-president, as was also the names of Messrs. Gainey and Zachritz. The last two nominated declined in favor of Mr. Hanson, and it was moved by Mr. Trapnell that the nominations close and that the secretary cast the ballot of the association for Mr. Hanson.

Seconded and carried, and Mr. Hanson's election was declared unanimous.

For Secretary and Treasurer the name of Stephen Skidmore was placed in nomination for re-election by Mr. Boutet, who moved that the nominations close and that the president cast the ballot of the association for Mr. Skidmore. Carried unanimously, and Mr. Skidmore was declared elected.

President Stark: As my retirement from the executive committee will cause a vacancy to be filled, I will now retire from the chair and introduce to you F. C. Schultz, your new president. I hope the organization will give him the hearty co-operation that they have always given me and that he will have a successful term in office. I will attach the president's badge, meaning authority over this body. Be sure you obey the orders of the new president.

President Schultz: I thank you for your kindness in electing me as your president to preside over this organization for the ensuing year, and assure you that words cannot express my appreciation.

The first meeting that I attended of this organization was at the request of the S. M. P.'s office, and I felt at that time that if men of this caliber asked me to attend the conventions of this association that there certainly must be something good in the organization, and I assure you that the thought that I had at that time has been verified many times since. I have noticed the influence of this organization since holding my present position as chief interchange inspector at Chicago, and having attended all of the conventions of the past seven years I am safe in saying, however, that at none of them has the interest been shown as has been manifested at this particular meeting that we are just closing. This indicates in my opinion that the interest of the members is constantly increasing, and also when the time of years comes around when recommendations are made to the arbitration committee of the M. C. B. Association by this association, for changes in the rules, that the recommendations of this association are given due consideration by the arbitration committee and the executive committee of the M. C. B. association, and as you know, many of the rules that now are in the M. C. B. book of rules were suggested by members of this organization. This organization is fast coming to be a very important factor in the handling of interchange of cars throughout the United States and Canada, and is one of the best influences that we have to bring about a uniform method and understanding of the M. C. B. rules and the handling of interchange business uniformly throughout the United States and Canada. This very point alone warrants us in constantly working to build up the influence of the organization.

The question of holding and increasing our membership is something that each one of us should give our attention. It is my personal experience that when approaching our car men who are eligible for membership in this organization that when I explained to them the benefits to be derived, they readily saw same and became members. If each one of us will take an interest in the matter and ask our associates who are eligible to become members the membership should be doubled in the next few years, and personally I can see a very bright future for this organization.

I hope that the members will give me the same support in the next year, while acting as president, that they gave to the gentleman who held this position before me.

I also want to say to you that if during this year any member of the organization has anything in mind which will benefit the organization, that he place his suggestion before me and I will be only too glad to work it out.

I again thank you for the honor bestowed upon me in electing me president of this association. (Applause.)

The following were unanimously elected members of the executive committee: F. W. Trapnell (chairman), W. R. McMunn, A. R. Kipp, C. J. Stroke, J. J. Devaney, J. P. Carney.

Mr. Hanson: I want to thank you one and all for the confidence you have placed in me in electing me your vice-president. I want to repeat what our president has just said. A few years ago, to my personal knowledge, a great many of our higher officers refused to let members who belonged to this association come to the meetings for the reason that they claimed that the meetings were not what they should be. I am glad to say that these people have changed their mind in the last three years, and they encourage their foremen now, for the good of the service, to attend the meetings, going so far in a good many cases as to pay their expenses while here. I am certainly going to do everything I can to influence our officials to pay the expenses of the men when attending these conventions. One of the editors said the master car builders were recognizing the recommendations being made by this association. We all know when it comes to recommendations the higher officials hand it down to the next man. They make their recommendations and the higher officials take it up and it goes back up the ladder. In my opinion the changes in the M. C. B. rules will have to come from the car foremen and inspectors. I am glad to know that this body is being recognized. I thank you for the confidence imposed in me.

Mr. Skidmore: There isn't any use in me taking up any time of the convention in speaking, because we expect the new members to do all the talking and get themselves acquainted in that manner. All I can say is that I thank you for the honor in re-electing me and I will try to serve you as I have in the past.

Mr. Boutet: I think we ought to hold our next meeting place south of the Ohio River. I think we would get some good results. And if we do go South it might be well to go in September.

On motion the executive committee was given power to change the date of meeting if they see fit.

It was suggested by Mr. Hanson that all members be notified of the meeting of the executive committee in order that they might attend if they desired.

Mr. O'Donnell suggested that the executive committee raise the dues of the members to $3.00.

The City of Richmond was suggested as a meeting place for next year in connection with the other cities previously spoken of.

Thereupon the convention adjourned.

LIST OF MEMBERS, C. I. C. I. & C. F. ASSN.

Abbot, H. G., A. G. C. I.—Pere Marquette R R., Detroit, Mich.
Acker, C. B., G. C. F.—P. S. & N. R. R., 725 Theresia St., St. Marys Pa.
Acker, Chas. L., M. M.—T. T. R. R., 209 Courtland Ave., Toledo, Ohio.
Adams, C. S., Asst. G. F.—N. Y. C. & H. R., 147 North Broadway, Yonkers, N. Y.
Allen, C. A., F. C. I.—N. Y. C. & H. R., 427 Potomac Ave., Buffalo, N. Y.
Alquist, Peter, S. C. D.—M. K. & T. R. R., Sedalia, Mo.
Anderson, C. G., G. C. F.—G. T. R. R., 428 English St., London, Ont.
Anderson, J. W., G. C. I.—258 Boulevard & Douglas Ave., Port Norfolk, Va.
Andrews, J. L., F. C. R.—E. P. & W. R. R., P. O. Box 738, Tucumcari, N. M.
Arndt, H. J., E. I—502 22nd Ave, Minneapolis, Minn.
Ashby, J. M., C. C. I.—N. Y. P. & N. R. R., Cape Charles, Va.
Backman, J., F. I.—N. Y. C. & H. R., 644 Polk St., West New York, N. J.
Baker, F. H., C. F.—N. Y. C. & H. R., Ravena, N. Y.
Baldwin, H., F. C. R.—M. C. R. R., 553 Victoria Ave., Niagara Falls, Ont., Canada.
Ballentine, G. F., C. I.—N. P. R. R., 2554 Hayes St., Minneapolis.
Baltz, Valentine, C. J. I.—Wheeling Terminal R. R., Wheeling, W. Va.
Barbot, Fred, C. C. Co.—6218 English Ave., Chicago, Ill.
Barker, W. E., C. C. I.—D. & H. Co., Sidney, N. Y.
Barnwell, J., C. C. I.—M. P. R. R., 5848 E. 11th St., Kansas City, Mo.
Bartlett, R. J., J. C. I.—Soo Line, Trout Lake, Mich.
Baughan, T. M., G. C. I.—C. G. W. R. R., Oelwein, Ia.
Bendixen, J H., Vice-Pres. Bettendorf Axle Co., Bettendorf, Ia.
Bennett, T., C. F.—C. G. W. R. R., South Park, Minn.
Benton, J. E., C. F.—G. T. R. R., Battle Creek, Mich.
Berg, A., G. F. C. D.—L. S. & M. S. R. R., 89 Park View Ave., Buffalo, N. Y.
Berg, R. M., P. W. I.—L. S. & M. S., P. O. Box 5, St. Clair Ave., Collinwood Sta., Cleveland, Ohio.
Bill, Geo. W., D. C. I.—Union Tank Line, Whiting, Ind.
Black, H. P., G. C. F.—C. & A. R. R., Venice, Ill.
Blackwood, J. H., G. C. I.—C. & O. R. R., Huntington, W. Va.
Blood, A., G. F.—L. S. & M. S. R. R., 611 East 21st, Erie, Pa.
Bohanon, Thos. E., J. C. I.—L. P. R. R., Fulton, La.
Bossert, Chas., A. C. I. C. I.—405 Grand Central Station, Chicago, Ill.
Boutet, B., A. C. I. C. I.—Carew Building, Cincinnati, Ohio.
Boutet, H., C. I. C. I.—Carew Building, Cincinnati, Ohio.
Brady, J. L., F. C. D.—L. & N. R. R., 1708 Greenup St., Covington, Ky.
Brady, John, Bettendorf Axle Co., Bettendorf, Ia.
Brandon, John, C. F.—Soo Line, Portal, N. D.
Brannon, J., A. C. I. C. I.—Carew Building, Cincinnati, Ohio.
Brenneman, C. D., F. C. D.—M. & O. R. R., Cairo, Ill.
Brett, W. J., C. F.—G. T. R. R., 119 Jackson St. Pontiac, Mich.,
Brownell, W. A., C. F.—N. Y. C. & H. R., 71 Hoffman St., Kingston, N. Y.
Bunting, G. M., Car Fmn.—Pennsylvania R. R., Cleveland, Ohio.
Burch, R. L., T. C. I.—K. C. S. R. R., 619 Cotton St., Shreveport, La.
Burke, John C., C. F.—M. P. R. R., 3001 Chauteau Ave., St. Louis.
Burkhard, A. A., A. G. F.—N. Y. C. & H. R., West Albany, N. Y.
Burns, L. J., E. I.—C. & O. R. R., The Berman, 8th & Madison Ave., Covington, Ky.
Calkins, A. E., N. Y. C. & H. R., 610 Grand Central Sta., New York.
Campbell, E. R., G. C. F.—Minn. Tran. R. R., St. Paul, Minn.
Carey, C. H., C. C. I.—E. J. & E. R. R., 9132 Greenwood Ave., Chicago, Ill.
Carey, W. M., M. F.—L. S. & M. S., 548 East 103d St., Cleveland.
Carney, J. P., G. I.—M. C. R. R., 661 14th Ave., Detroit, Mich.
Carpenter, F. T., Flush Car Door Co., 15311 Waterloo St., Cleveland.
Carr, W. K., G. C. I.—N. & W. R. R., Roanoke, Va.
Carter, J. B., G. F.—C. & O. R. R., Huntington, W. Va.
Cassidy, G. F., F.—N. Y. O. & W. R. R., Weehawken, N. J.
Caton, S. W., G. C. I.—W. M. R. R., Hagerstown, Md.
Cebulla, Fred, C. F.—G. N. R. R., Superior, Wis.
Cerornski, Paul, C. F.—Soo Line, Bismarck, N. D.
Chaffee, F. W., G. C. I.—N. Y. C. & H. R., N. Y. C. Sta., Albany, N. Y.
Charlton, C., C. F.—P. C. C. & St. L. Ry., Cincinnati, Ohio.
Chesher, Earl, C. I.—G. T. R. R., Port Huron, Mich.
Chubb, A. J., C. I. C. D.—P. M. R. R., Detroit, Mich.
Church, J. W., C. C. I.—F. E. C. R. R., Jacksonville, Fla.
Clark, I. N., A. C. I. C. I., 4521 West End Ave., Chicago, Ill.
Cody, E. F., G. C. F.—G. T. R. R., Battle Creek, Mich.
Coleman, Geo. D., C. C. to C. I.—A. B. & A. R. R., Atlanta, Ga.
Coleman, John, A. C. I. C. I., 758 West 9th St., Cincinnati, Ohio.
Colson, A. C., G. F.—L. S. & M. S., Dunkirk, N. Y.
Combs, F. M., C. F.—M. & St. L. R. R., Minneapolis, Minn.
Constant, E. J., A. C. I. C. I.—1042 W. Garfield Boulevard, Chicago.
Corbett, J. B., C. C. C. D.—N. Y. C. & H. R., 660 Madison St., West New York, N. J.
Corkran, H., C. B. C.—C. & O. R. R., Richmond, Va.
Costley, C. M., C. J. C. I., Cairo Terminal, Cairo, Ill.
Covert, M. F., A. M. C. B.—Swift's Ref. Line., Chicago, Ill.
Cox, W. D., T. I.—W. & L. E. R. R., Toledo, Ohio.
Cross, A. B., Rep. Frost Paint Co., 1200 Karpen Building, Chicago, Ill.
Cunningham, W., C. F.—P. M. R. R., Detroit, Mich.
Curran, J. W., G. C. I.—B. & O. R. R., 509 Overton St., Newport, Ky.
Decker, G. E., C. F.—G. T. R. R., Durand, Mich.
Deitche, J. J., G. F.—Pere Marquette R. R., Chicago, Ill.
Demint, S. A., Chf. Int. Car Ins., Shreveport, La.
Denne, Arthur, C. J. C. I.—D. L. & W.—Erie—& D. & H. Co., Binghamton, N. Y.
Derby, Charles, Joyce-Cridland Co., Dayton, Ohio.
Devanney, J. J., F. C. D.—T. R. R. A., 3426 Eads Ave., St. Louis, Mo.
Deyot, Frank, A. G. F.—N. Y. C. & H. R., 1002 Fillmore Ave., Buffalo, N. Y.
Diebert, J. H., F. C. R.—L. V. R. R., 316 Fenton St., Buffalo, N. Y.
Dixey, J., M. C. B.—D. S. D., 6326 Winchester Ave., Chicago, Ill.
Donahue, J. P., F.—L. T. R. R., 348 Georgia Ave., Lorain, Ohio.
Donahue, T. J., F.—N. Y. C. & H. R., 218 Hauge St., Rochester, N. Y.
Dormer, H. J., G. C. F.—T. T. R. R., 2028 Mich. St., Toledo, Ohio.
Dow, A. M., Fmn., E. P. & S. W. R. R., 2623 E. Boulevard, El Paso.
Duckworth, A., F. C. D.—G. T. R. R., 77 Alma St., St. Thomas, Ont.
Dunkin, J. B., F.—L. S & M. S., 14606 St. Clair Ave., Collinwood, Ohio.
Dunlop, Henry, C. F.—N. Y. C. & H. R., 127 Buffam St., Buffalo, N. Y.
Dunn, P. T., M. M.—Penn. R. R., Wellsville, Ohio.
Dyer, Jos., C. J. I.—Erie R. R., Youngstown, Ohio.
Dyer, R. H., D. C. I.—N. & W. R. R., Portsmouth, Ohio.
Ebert, H. L., U. T. L.—10021 Ave. M, So. Chicago, Ill.
Edmonds, B. F., F. C. I.—St. L. & S. F. R. R., 1815 Booneville St., Springfield, Mo.
Edwards, J., G. C. I.—M. C. Co., 9328 Luella Ave., So. Chicago, Ill.
Egan, J. W., F.—Erie R. R., Nillson Ave., Cleveland, Ohio.
Eipper, J. E., Columbia Bolt & Nut Co., 4322 N. 41st Ave., Chicago, Ill.
Elliott, W. P., F. C. D.—W. F. Co., 1218 N. 15th St., E. St. Louis, Ill.
Emerson, C. H., M. C. B.—E. J. & E. R. R, Joliet, Ill
England, R. H., Vice-Pres. Cent. R. R. of Ore., Rochester, N. Y.
Engle, E. T., G. C. F.—St. L. R. M. & P. R. R., Box 185, Cimarron, N. M.
Erickson, E., F.—C. I. & S. R. R., 881 Erie St., Hammond, Ind.
Erickson, Otto, J. C. I.—N. P. R. R., 6 N. 39th Ave., W. Duluth, Minn.
Estrup, H. H., C. F.—C. & E. I. R. R., 509 W. 59th St., Chicago, Ill.
Eubanks, O. G., C. C. I.—Atlantic C. L., Montgomery, Ala.
Eyman, T. A., C. C.—E. J. & E. R. R., 112 Thayer Ave., Joliet, Ill.
Faeber, A., C. F.—N. Y. C. & H. R., 51 Girard Place, Buffalo, N. Y.
Farnum, W. E., G. C. I.—C. & E. I. R. R., Danville, Ill.
Farran, J. F., G. F. C. R.—C. L. & N. R. R., Terrace Park, Ohio.
Farrell, Martin, C. I.—Soo Line, Minneapolis, Minn.
Farrling, E. S., G. F.—N. Y. C. & H. R., 517 Washington Ave., Jersey Shore, Pa.
Fehl, N., F. C. R.—Penn. R. R., 3426 Golden Ave., Cincinnati, Ohio.
Ferguson, J. F., F. C. D.—Southern Ry., E. St. Louis, Ill.
Flanagan, Harry, C. C. to M. C. B.—G. N. R. R., St. Paul, Minn.
Fletcher, Henry, G. C. F.—Ft. W. & D. R. R., Childress, Tex.
Fletcher, John, G. F.—C. R. I. & P. R. R., 1520 Desota Ave., St. Louis, Mo.
Forbes, R. E., A. C. I. C. I.—Congress Park, Ill.
Forrest, J. H., C. F.—T. & O. C. R. R., 682 Wallbridge Ave., Toledo, Ohio.
Fox, Geo. P., G. F. C. D.—N. Y. C. & H. R., 430 Elk St., Albany, N. Y.
Fraser, Donald, I.—G. T. R. R., 745 16th St., Port Huron, Mich.
Frey, W. J., G. C. F.—L. E. & W. R. R., Lima, Ohio.
Fryer, H. H., Rep. S. C. L., 29 Live Stock Exchange, Buffalo, N. Y.
Fullerton, D. K., G. C. F.—N. P. R. R., Brainard, Minn.
Funk, John, G. C. F.—Soo Line, Kolze, Ill.
Gainey, J. J., G. C. F.—C. N. O. & T. P. and A. G. S. R. R., Ludlow, Ky.
Gallary, T. F., P. W. I.—N. Y. C. & H. R., 186 Fargo Ave., Buffalo, N. Y.
Getzen, J. M., A. A.—N. Y. C. & H. R. Shops, East Buffalo, N. Y.
Gilman, G. H., M. C. B.—N. P. R. R., 1421 Capitol Ave., St. Paul, Minn.
Givan, P. S., Car Fmn.—L. & N. R. R., Cincinnati, Ohio.
Goolsby, A. G., F.—E. P. & S. W. R. R., 417 San Marcial, El Paso, Tex.
Grandstaff, C. F. B., J. C. I.—B. & O. R. R., 1053, Cherry St., Wheeling, W. Va.
Grant, E., C. F.—S. P. & S. R. R., Vancouver, Wash.
Gratrick, W. G., C. F.—Soo Line, 2632 Buckhanan St., Minneapolis, Minn.
Greenseth, Henry, C. F.—Soo Line, 2613 Bank Ave., Superior, Wis.
Gurnee, A. R., J. C. F.—N. Y. O. & W. and C. & N. E. R. R., Campbell Hall, N. Y.
Halbert, M. W., C. I. C. I. Relay Depot, East St. Louis, Ill.
Hall E. H., D. G. F.—C. & A. R. R., 4458 Green Ave., St. Louis, Mo.
Hanson, F. H., A. M. C. B.—L. S. & M. S., 639 E. 101st St., Cleveland, Ohio.
Hartough, E. W., Genl. Fmn.—Pere Marquette R. R., Chicago, Ill.
Harvey, H. H., G. C. F.—C. B. & Q. R. R., 4420 No. Winchester Ave., Chicago, Ill.
Head, Eugene, C. C, C. D.—Wabash R. R., Springfield, Ill.
Heil, W. G., F. C. D.—M. K. & T. R. R., 306 Coledge Ave., Rosedale, Kansas.
Heinecke, C. C., A. F.—N. Y. C & H. R., 209 3rd St., Union Hill, N. J.
Helwig, P. W., G. C. F.—M. & St. L. R. R., Cedar Lake Shop, Minneapolis, Minn.
Hewitt, C. C., N. Y. C. & H. R., 243 Maple St., Buffalo, N. Y.
Hill, H., C. F.—C. C. C. & St. L. R. R., Elmwood, Ohio.
Hitch, C. M., G. F.—C. H & D. R. R., Lima, Ohio.
Hittabiddle, O. P., A. G. F.—W. R. R., 75th St. and Western Ave., Chicago, Ill.
Hodgson, J. L., M. C. B., Grand T. P., Transcona, Man.
Hogan, M. F., A. C. F.—L. V. R. R., 434 Clark St., Waverly, N. Y.
Hogsett, J. W., C. I. C. I., Fort Worth, Tex.
Holcroft, W. H., T. I.—M. K. & T. R. R., 401 W. 10th St., Sedalia, Mo.
Hood, J., F. C. R.—C. & O. R. R., Silver Grove, Ky.
Hornby, S., C. F.—G. T. R. R., Port Huron, Mich.
Howe, S. C., D. A.—N. Y. C. & H. R., 10 Colby St., Albany, N. Y.
Howe, E., G. F.—M. C. R. R., Box 407, Bridgeburg, Ont., Canada.
Hubert, W., F. I.—N. Y. C. & H. R., 29 Newton St., Buffalo, N. Y.
Hurley, S. P., C. F.—N. P. R. R., Minneapolis, Minn.
Imhof, T. O. J., C. C. to C. I. C. I.—T. T. R. R., Toledo, Ohio.
Iseringhausen, F. J., J. C. I.—424 Bilbo St., Lake Charles, La.
Jeffries, G. L., C. F.—C. & O. R. R., Richmond, Va.
Jennings, J., J. C. I.—El Paso & Juarez, 417 N. El Paso St., El Paso, Tex.
Johnson, A., C. F.—N. Y. C. & St. L., 7402 Ellis Ave., Chicago, Ill.
Jolly, C. L., F. C. D.—N. Y. C. & H. R., 87 W. Erie Ave., Corning, N. Y.
Jones, Edwin, G. F. C. D.—D. & H. Co., Oneonta, N. Y.
Jones, W. E., C. C. I.—A. B. & A R. R., 57 English Ave., Atlanta, Ga.
Jorgensen, Otto, C. F.—N. P. R. R., 957 Desota St., St. Paul, Minn.
Justus, I. J., S. I. N. Y. C. & H. R., 1514 Grand Central Sta., New York, N. Y.
Kemmet, M. A., G. C. F.—C. R. R. of N. J., Ashley, Pa.
King, Adam, F. C. R.—G. T. R. R., 2310 3rd St., Port Huron, Mich.
Kipp, A., G. C. I.—N. Y. O. & W. R. R., Middletown, N. Y.
Koep, O. F., A. C. I. C. I., 7252 So. May St., Chicago, Ill.
Krueger, A. J., P. W. I.—L. S. & M. S. R. R., Cleveland, Ohio.
Krush, Henry, C. F.—Soo Line, Manitowoc, Wis.
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Lang, C. W., C. F.—C. C. C. & St. L., 2885 Erie Ave., Hyde Park, Cincinnati, Ohio.
Laughlin, G. F., Supt., Armour Car Lines, Chicago, Ill.
Lavis, W. K., F. C. D.—C. B. & Q. R. R., 1625 So. Western Ave., Chicago, Ill.

Lawson, A., F.—N. Y. C. & H. R., Exchange St., Buffalo, N. Y.
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Lindquist, H., C. F.—Great Nor. R. R., St. Paul, Minn.
Livingston, G. C., C. F.—H. V. R. R., 664 South Hawley St., Toledo, Ohio.
Lucore, F. M., A. G. M.—Sunset Central Lines, Houston, Tex.
Luckie, Geo. O., D. G. F.—C. & A. R. R., 4048 St. Louis Ave., St. Louis, Mo.
Ludford, Geo., C. F.—Soo Line, 1121 Churchill Ave., St. Paul, Minn.
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Lynch, Geo., C. I. C. I., Erie Depot, Cleveland, Ohio.
Macpherson, A. F., Vice Pres., Bettendorf Axle Co., Chicago, Ill.
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Mann, S., C. F.—Mich. Central R. R., Detroit, Mich.
Mansker, K. W., F. M. P. & C. D.—H. & T. C. R. R., Box 116, Lampasas, Tex.
Marquart, R. H., C. F.—B. & O. R. R., 532 Washington Place, E. St. Louis, Ill.
Martin, Geo., National Malleable Castings Co., Cleveland, Ohio.
Martin, H. A., G. C. F.—B. & A. R. R., Milo Junction, Maine.
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Mathay, H., L. & C. F.—B. R. R., Erie, Pa.
Mathews, F., A. C. I. C. I., 6127 Honore St., Chicago, Ill.
Mauphin, Lee, C. F., 412 Union Station, St. Louis, Mo.
Maurer, H. W., F. C. I.—Soo Line, 1000 24th Ave., N. E., Minneapolis, Minn.
Mayer, W. H., F. C. D.—C. C. C. & St. L., 520 No. Madison St., Bellefontaine, Ohio.
McBay, Wm., M. C. B. A.—G. T. R. R., Transcona, Man., Canada.
McBrian, Jas., D. C. I.—C. R. I. & P. R. R., 423 So Min. St., Shawnee, Okla.
McCormack, J. E., G. C. F.—Sou. R. R., Box 59 Spencer, N. C.
McDonald, Geo., D. C. I.—C. R. I. & P. R. R., 32 No. Boeke St., Kansas City, Kan.
McDonald, W. T., F. C. D.—G. S. F. & F. R. R., Macon, Ga.
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Meek, A. S., 1306 Rosevelt St., Bloomington, Ill.
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Nelson, J. C., C. I.—G. T. R. R., 725 12th St., Port Huron, Mich.
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Niehaus, R. H., F. C. D.—W. R. R., 4135 Flad Ave., St. Louis, Mo.
Nightingale, W. C., C. I.—G. T. R. R., 5124 Homer Ave., Chicago, Ill.
Nightingale, Henry, C. F.—G. T. R. R., Chicago, Ill.
Nihill, P., C. J. C. I., 43 Pearl St., Westfield, N. Y.
Nordquist, Chas., F. C. D.—C. & E. R. R., 5518 Peoria St., Chicago, Ill.
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Pennrith, W. H., C. C. M. D.—M. & St. L. R. R., Cedar Lake Shops, Minneapolis, Minn.
Pfister, J. G., G. C. F.—N. Y. C. & H. R., 909 McBride St., Syracuse, N. Y.
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Schattler, A. F., 705 13th St., Port Huron, Mich.
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Shamp, Wm., G. I.—C. B. & Q. R. R., Aurora, Ill.
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Shaver, C. B., F. C. D.—St. L. T. & E. R. R., 408 North 14th St., E. St. Louis, Ill.
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Stachewic, J. B., G. F.—Erie Car Works, Erie, Pa.
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St. Cyr, A. T., A. F. I.—L. S. & M. S., 52 Cook St., R. F. D. No. 1. Ashtabula, Ohio.
Steele, Hugh, Mgr.—C. R. D. Co., 1304 First Natl. Bank Bldg., Chicago, Ill.
Stenholm, G., C. I.—Soo Line, Escanaba, Mich.
Stenson, J. D., G. C. I.—T. & N. O. R. R. Shop, Houston, Tex.
Stock, S., F. C. R.—D. L. & W. R. R., 226 Longnecker St., Buffalo, N. Y.
Stokes, J. G., F. C. D.—M. C. R. R., 1414 South St., Toledo, Ohio.
Stoll, W. J., C. I. C. I.—228 Terminal Building, Toledo, Ohio.
Geneva, N. Y.
Stonehouse, F. C., F. A. B. D.—H. V. R. R., Columbus, Ohio.
Story, C. M., T. C. I.—St. L. & S. F. R. R., 450 South St., Springfield, Mo.
Stroke, C. J., A. G. F.—N. Y. C. & H. R., 90 Ideal St., Buffalo, N. Y.
Studdard, F., C. I.—G. T. R. R., Pontiac, Mich.
Stuff, H. B., F. C. R.—Penn. R. R., 3462 Linwood Ave., Cincinnati, O.
Sutton, W. E., C. F.—L. V. R. R., 445 Broad St., Waverly, N. Y.
Swamson, C. N., S. C. S.—A. T. & S. F. R. R., 130 Clay St., Topeka, Kan.
TenBroeck, L. J., F.—D. & H. & N. Y. O. & W. R. R., Sidney, N. Y.
Thayer, R. E., A. M. E.—Ry. Age Gazette, 608 Dearnborn St., Chicago.
Thompson, C. W., F. C. D.—N. Y. C. & H. R., 83 Water St., Lyons, N. Y.
Thonley, R. K., F. C. D.—Atlantic C. L., Charleston, S. C.
Totten, E. C., D. G. C. F.—N. Y. C. & H. R., Weehawken, N. J.
Trapnell, F. W., C. I. C. I., 14 Union Depot Annex, Kansas City, Mo.
Turney, E. E., S. S. C. D.—M. & St. L. R. R., Marshalltown, Ia.
Vittum, J. E., C. I. C. I., 396 North High St., Columbus, Ohio.
Waitt, G. L., M. I.—N. Y. C. & H. R, 41 North Ashland Ave, Buffalo, N. Y.
Wallace, Wm., C. F.—L. S. & M. S., 13708 Rugley Road, Cleveland, O.
Ward, A., G. C. F.—P. M. R. R., St. Thomas, Ont., Canada.
Warnholz, L. H., C. F.—G. N. R. R., Sioux City, Ia.
Watts, Geo., C. I.—Natl. Stock Yards, E. St. Louis, Ill.
Weale, J. H., F. C. D.—N. Y. C. & H. R., W. 65th St., New York, N. Y.
Weber, G. A., C. C. D.—L. S. & M. S., 529 W. 17th St., Erie, Pa.
Weiss, J., F. C. R.—C. H. & D. R. R., 424 Linden St., Elmwood Place, Ohio.
W[illegible] F. W., F. C. D.—Atlantic C. L., Florence, S. C.
Westall, W., G. F. F. R.—L. S. & M. S. R. R., Cleveland, Ohio.
Whitney, C. M., G. C. F.—St. L. & S. F. R. R., 1100 Chelsea Ave., Memphis, Tenn.
Wilcox, A. F., M. C. B.—Jacob Dold Packing Co., Buffalo, N. Y.
Wilkinson, F., D. C. F.—A. T. & S. F. R. R., 3127 W. 38th St., Chicago, Ill.
Williams, J. W., A. C. F.—P. S. & N. R. R., 430 Washington St., St. Marys, Pa.
Williamson, W. D., J. C. I.—L. S. & M. S., R. F. D. No. 3, Green-
Willis, E., C. I.—G. T. R. R., 387 North Saginaw St., Pontiac, Mich.
Wilson, R. D., A. C. I. C. I.—P. & R., 154 W. Windsor St., Reading, Pa.
Wilson, Robert, C. F.—Soo Line, Manistique, Mich.
Wilson, W., C. F.—Soo Line, Sault Ste. Marie, Mich.
Wilson, W. R., G. F. C. D.—L. S. & M. S., 103 Emery St., Toledo, O.
ville, Pa.
Woollatt, Harry, C. F.—P. M. R. R., 228 Colbourne St., London, Ont., Canada.
Wright, W. S., G. C. F.—E. St. L. & S. Ry., E. St. Louis, Ill.
Wymer, C. J., G. C. F.—B. R. R. of C., 83rd St. and Vincennes Road, Chicago, Ill.
Zachritz, Geo. P., G. C. I.—Soo Line, Excelsior, Minn.
Ziebold, A., G. C. I.—H. V. R. R., 617 Outlook Building, Columbus, O.
Zielke, W. C., C. I.—G. T. R. R., 2212 15th St., Port Huron, Mich.
Zorin, C., G. C. I.—Soo Line, Stevens Point, Wis.

The Canadian Pacific, it is said, will make large extensions to the Angus shops at Montreal, Que., which will include the erection of two material shops, passenger car shop, freight car shop, bolt and nut shop and extensions to the locomotive shop. This road also plans to enlarge its freight terminals at Toronto, Ont., at a cost of about $1,200,000.

Recent Railway Mechanical Patents

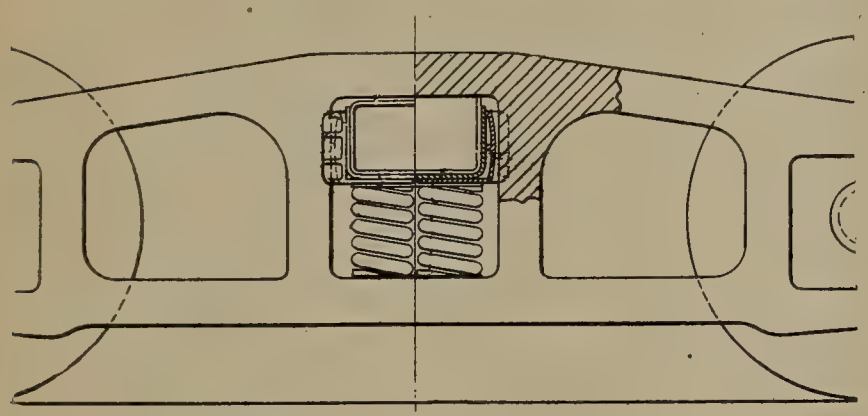
BOLSTER-GUIDE PLATE FOR CAR TRUCKS.

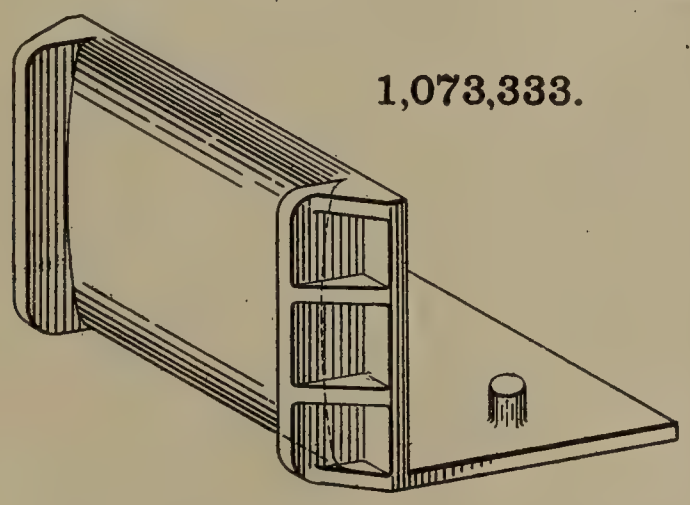
1,073,333—Alfred Copony, Port Huron, Mich.

This invention relates to bolster-guide plates for railway car trucks.

In the usual construction of trucks for railway cars, more particularly freight cars, the side truck frames are provided with upright truck columns, generally in vertical arrangement and spaced apart, between which columns are arranged bolster-guide plates seated upon the truck springs, the bolster-guide plates being in sliding engagement with the columns and bearing the ends of the truck bolster. Heretofore the bearing surfaces of the bolster-guide plates at the point of their engagement with the truck columns have been substantially kept parallel to the adjacent faces of the truck column, and as a result thereof when one set of wheels of a truck have been derailed without derailing the other set or sets of wheels, the bolster-guide plates have bound between the truck columns, thus tending to spread the truck columns and seriously damaging the truck. It is necessary in car construction that there should be only a slight clearance, substantially not more than one-eighth of an inch, between the bolster-guide plates and the truck column, so that blows caused by buffing shocks will be transmitted from the truck bolster to the truck frame with a minimum of movement of the truck bolster.

The object of this invention is to provide for this minimum clearance between the truck bolster and truck frame at their points of interengagement, and at the same time provide bolster





1,073,333.

guide plates which will permit the derailment of one set of wheels of a truck without binding the truck bolster between the truck columns.

The upper drawing in the figure is a side elevation of a truck frame with the bolster and bolster guide plates in position, part of the truck frame being broken away, the bolster and bolster plates being partly in cross section.

The lower drawing is a perspective view of one of the bolster guide plates.

The bolster guide plates are preferably two in number for each side frame, each of the bolster guide plates comprising an upright member engaging one side of the truck bolster at its inner face and having the curved outer or bearing face adapted to engage against the adjacent truck column. One of these bolster guide plates is arranged at each side of the truck bolster between the truck columns of each side truck frame.

It will be apparent that in the event of derailment of one set of wheels, causing the truck frame to be lowered at one end and a consequent change in the relative positions of the truck frame and car body, that the truck bolsters bearing the weight of the car body will tend to turn within the opening of the truck side frame, and that by reason of the curved bearing face with which each of the bolster guide plates is provided there will be no binding of the plates.

SUPERHEATER.

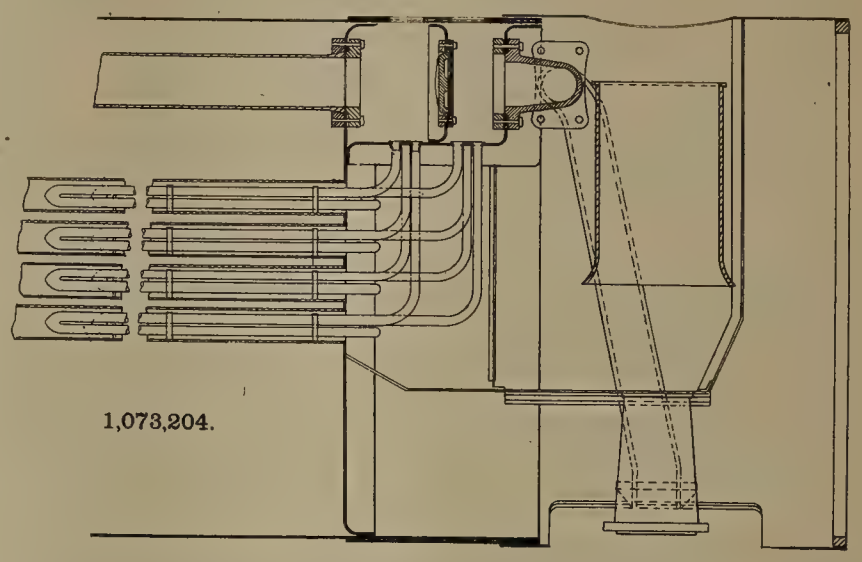
1,073,204—Charles D. Young, Altoona, Pa.

This has for its primary objects the provision of a superheater which can be more cheaply applied and having tighter and better joints between the tubes and headers than in the superheaters of the general type heretofore used; the provision of a superheater having an improved arrangement permitting the ready removal of the dry pipe therethrough; the provision of a superheater wherein the tubes are supported in the fire tubes in an improved and superior manner; and in general to simplify, cheapen and improve locomotive superheater constructions.

As indicated in the figure, the headers are formed of sheet metal, the upper wall being in effect an extension of the outer sheets of the boiler, and the ends and bottom walls serving to close in the space below the wall and to the front of the tube sheet. The space thus provided is divided into compartments by means of a partition wall.

Each of the superheater coils is arranged in four lengths, one end of each being expanded into the bottom sheet of the headers to the rear of the partition wall and the other end being expanded into the said sheet to the front of the partition wall. By this arrangement the steam supplied through the dry pipe to the rear header passes through the coils and into the front header, from which header it is supplied to the cylinders of the locomotive.

In order to permit of the expanding of the ends of the superheater tubes into the lower wall of the headers, hand holes are provided in the upper wall of the headers. These hand holes are so arranged as to permit ready access of the tools necessary for expanding the ends of the tubes into the lower wall of the headers.



1,073,204.

In order to provide access to the dry pipe the removable T is arranged in alinement with the end of the pipe and an opening is cut in the partition wall between the end of the dry pipe and the T, such opening being normally closed.

The construction is one which can be cheaply applied to the ordinary type of locomotive, and all of the tube connections with the headers may be made without difficulty by expanding the ends of the tubes into the headers in the ordinary way, thus avoiding the necessity of using the more expensive and less effective joints secured by the use of bolts and ball- or gasket joints. The ends of all the superheater tubes are accessible through the hand holes, and the arrangement is such that any set of tubes may be readily removed for replacement or repair. The drp pipe is also readily accessible for replacement or repair by reason of the use of the removable T.

STATEMENT AS TO THE OWNERSHIP AND MANAGEMENT OF THE RAILWAY MASTER MECHANIC, IN ACCORDANCE WITH ACT OF CONGRESS, AUGUST 24TH, 1912.

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The officers are as follows:

President—William E. Magraw, 431 So. Dearborn St., Chicago.
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(Signed)
WILLIAM E. MAGRAW, PRESIDENT.

Sworn to and subscribed before me this 26th day of September, 1913.
(Signed) Robert R. Grieg,
Notary Public.
(My commission expires Oct. 26, 1915.)

RAILWAY MASTER MECHANIC

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Published at the World's Greatest Railway Center
Established 1878
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An Element in Avoiding Regulatory Legislation

In recent railway disasters where the blame has been found to rest with employes who are remiss in judgment or duties, the public has found, as usual, additional reason for further regulatory legislation for protection; thus embarrassing the railways to a still greater extent in the operation of their trains.

Every railway employe holds his position by virtue of having qualified by actual experience and hard work, and up to this point neither he nor the operating officials over him can be held as remiss in instruction or knowledge, but the weak link in the chain is usually the fact that he has not a clear or general idea of how his duties dovetail with the work as a whole. Systematic lessons and examinations would quickly overcome this defect, and it would appear the part of wisdom on the part of railway executives to take steps to so fortify their employes as to be able to disprove any charge of inefficiency and thereby avoid the condition of unjust surveillance that would only tend to cripple the service with no compensating advantage.

A Suggestion

During the past year safety rallies have been held in a number of large cities which were participated in by all the roads entering them and they have proved helpful in arousing enthusiasm and interest in the movement. No meeting of this sort has as yet been held in Chicago, which has something over two dozen roads entering its borders. Possibly a monster mass meeting with special trains run into the city from outlying districts would not be feasible. However, could not the Western Railway Club, the Car Foremen's Association and other railway clubs of the city decide on a joint meeting in some large auditorium, to be known as a "Safety First" meeting. Certainly with all the railway men in these clubs and those who would be invited, a meeting could be held which would at least stimulate a great deal of interest. A "Safety First" committee covering automobile and similar accidents has recently been appointed by the municipal government of Chicago, and such a meeting would be an opportune time to let the public know that "Safety First" is a familiar word among railway men.

Joe Taylor Moves

Joe Taylor, secretary of the American Railway Master Mechanics' Association, the Master Car Builders' Association and the Western Railway Club, moved on November 1 from the Old Colony building to the Karpen building, 910 South Michigan Ave., Chicago. The new quarters are in the northwest corner on the eleventh floor and occupy over double the floor space used in the old location. There is an outer office, a private office, a vault, store room and a committee room, 24x32 feet, the latter about the size of the entire space in the Old Colony building. This commodious committee room is something which has long been needed, and nobody but Joe Taylor, perhaps, knows how much it is appreciated. With somewhere around a dozen committee meetings a month, the attendance of some of them being between forty and fifty, it was often necessary to engage a room elsewhere when in the old quarters. The library of the Western Railway Club is placed around the walls of the committee room and it is used as a reference room when not used as a committee room.

This makes twice that the associations have outgrown their quarters since Joe Taylor has been secretary. If Joe remains secretary a few years longer the associations will become so prosperous and influential that a separate building may have to be put up. Joe became secretary in 1889, with two small rooms in The Rookery building, and along in 1904 was crowded out of these quarters into larger ones in the Old Colony building. One of the handy features of the offices at the Karpen building is the grill room just across the hall. This will enable committee meetings to be pulled off with less waste of time and incidentally it will be a pretty good thing for Joe just before the June conventions. The offices of the American Railway Engineering Association are also on the tenth floor of this building. Let us hope the two associations will get as close together as their offices are.

Decatur Shops

The Wabash Railroad, long in need of adequate shop facilities, has just put new shops into operation at Decatur, Ill., a complete description of which will be found elsewhere in this issue. Not only does this give the Wabash a modern plant, but it places it at a far more logical place on the system than Springfield, for Decatur is at the intersection of two main lines and equidistant from a number of important points. The road is fortunate in having such a central point and in having brought its shops to it.

Although most shops constructed at the present time have many praiseworthy features, the new shops at Decatur cannot but impress the visitor. At first glance it does not appear to be a very extensive layout, and indeed it is not as far as the number of buildings is concerned. The locomotive shop, however, is over 1,100 feet in length, ranking as one of the largest railway shop buildings in the country, and houses the repair shop, tank shop and boiler shop under one roof. Although this is a day of well-lighted shops, the lighting of this shop is easily its most striking characteristic and is due to two features, the painting and the clere-story arrangement. Practically everything in the building except the tools is painted white, even including the cranes, and the result is that the illumination of the interior is greatly increased, either with natural or artificial light. The general lighting system includes the modern flaming arc type of lamp. An ingenious "bay window" effect practically doubles the window space on the clere-story. These "dog-houses," as they are called, allow the light to come in from three different directions, not only giving a better diffusion to the light entering the main bay, but serving the balconies as well. A well-lighted shop such as this is going to save many minutes of the workmen's time, in addition to the inestimable effect on the mental attitude of the men. In this connection it is worthy of note that the shop works 850 men and that there are 875 steel lockers in the lavatories. Every detail in the shop has been carefully worked out, as, for instance, the laying of conduits in the grouting, which come up out of the floor at the proper place at each machine. The machine tools are new and were bought for their worth and not for their cheapness. The best of everything, but no waste, seems to have been the motto of the designer. In a number of places scrap rods, tubes and rails have been employed to advantage in some of the details, as, for instance, the use of old rails in the sheet steel racks. Another evidence of the conservation of waste is the pumping of the warm compressor jacket water for use in the lavatories.

The shops are laid out on rather low ground, and water trouble was encountered with the foundations. However, this should not interfere with their operation. It is rather unfortunate that a street cuts through the grounds between the locomotive and the car shops, although evidently this could not be avoided.

The shops were designed and completed within a year, and this, together with the fact that nothing seems to have been left undone, reflects a great deal of credit on those who planned and worked out the details. The Wabash may well feel proud of its new shops at Decatur.

Training the Railway Employee

"The railway official has, as one of his problems, the training of men to fill positions of responsibility." This is the opening sentence of an interesting and thought-suggesting paper recently read before the Western Railway Club by A. Kipp and published elsewhere in this issue. That sentence is a concise statement of the situation. One of the broader duties of a railway official is the training of men to fill higher positions, but comparatively few realize it. The man who expects to grow with the railway, be he a foreman or superintendent of motive power, is not fulfilling his entire duty if he does not give his subordinates the knowledge and training necessary to fill a higher position. This means giving the man immediately under him an opportunity of seeing and studying the problems which have to be met in the higher position, so that when the time comes he may be prepared to fill such a position. It also means taking him into confidence to a certain extent. There are men with whom this cannot be done without swelling their heads out of shape, and such a man is not worth worrying over. The man who is willing to learn is an asset to the company, and no man can afford not to take such a man into his confidence. With very few exceptions the men who have gained distinction and position are men who have done this.

The official who is well up in the ranks, however, has problems to deal with in training the railway employee, aside from the encouragement of the man directly below him. This is in making provision for the training of men entering the ranks, so that there shall always be good, available material to make into officials in the future. This involves the apprentice question and the creation of an incentive for men to stick in the work. The above mentioned paper brought out quite a discussion with regard to college graduates in railway work and the apparently small number who remained in it, which brought forth the remark from Mr. DeVoy that the railway game was too strong a game for the college graduate. However, Mr. DeVoy, himself a Cornell man, disproves that and goes to prove that if it is a strong game, it has made some strong men. The railway game is a strong game, and though we do not think it is a reflection on college graduates, it is a fact that the number of technical college graduates in the mechanical departments of our railways is surprisingly small. A record of the graduates of the engineering college of one well-known university in 1911 showed not one connected with the mechanical department of railways out of a total of 1,386 graduates. However, 62 were shown as being in the maintenance of way, bridge and signaling departments, showing that the proportion which went to the engineering departments was comparatively large. Dean Benjamin, of Purdue University, states that from a census com-

piled of its graduates in 1911 that some 25 per cent of the graduates in mechanical engineering were in railway mechanical work and about 50 per cent of the graduates in civil engineering were in the engineering departments of railways. These figures seem rather high, although Purdue is noted for its railway testing laboratory and the work of its faculty along these lines. However, the average percentage in railway mechanical work is low, although it appears that the engineering department is pretty well supplied. It is not our purpose to discuss the merits and demerits of the technical college graduate at length. There are arguments on both sides. However, the man who has taken a technical college course should be distinguished from the one who has taken a course in history, languages and science. We believe that the average man entering college would be better fitted and would make a greater success by taking a technical course, even if he does not expect to engage in engineering work after graduation. He will be better fitted to earn his bread and butter than he will if he studies Latin, Greek and the Darwin theory. The training of the mind along practical lines is necessary for success, and this the college tries to do quicker on the whole than it can be done otherwise.

If a shop is getting castings full of blow-holes it cannot turn out a good finished product, and the foundry is immediately notified that such castings will not be accepted. One of the faults of our colleges today is that they are not inspecting their castings closely enough, and when their products are turned out some of them show poor material and won't stand up to the work. You can't build a good machine when your castings are full of blow-holes, and it is money wasted. True, a certain scholarship standard is required for entrance, but no inquiries are made as to the entrant's character, his circumstances and his reasons for going to college. If the boy about to enter college had to have the recommendation of an impartial commission in addition to certain scholarship requirements it might free our colleges of some "bad castings."

The majority of technical graduates, however, are ambitious, square and willing to learn. Such a man can be developed into a valuable asset to his company. Then why is the mechanical department not receiving its share of graduates? Although the mechanical departments have their supply of bright, strong men, surely they have not got to the point where they can ignore all possible sources of good raw material. Railway mechanical departments make no effort to get these technical men, whereas the electric companies, the telephone companies and large manufacturing companies not only write in for graduates, but send representatives to the schools to personally interview the men. Is it to be wondered at that so few find their way into the mechanical departments of railways with the inducements held out in other lines. A large number of college men enter the special apprentice courses of the General Electric Co. and the Westinghouse Companies every year, and it is certain that a large number would take advantage of similar courses if offered in the mechanical departments of railways. No effort to speak of is made by the engineering departments to obtain graduates, but as the civil engineer has always been connected with railway progress, it is more natural for him to go into this branch of railway work.

The time is here when the railways must look to the source from which their employees are coming. Their closer touch with the public, the "Safety First" movement and the demand for a more efficient management are pointing out the fact that the men who enter the service and who are being trained to future positions of responsibility must be men who will learn, and men who respect the rights and lives of others. To be called a "railway man" is to be given a title of honor, and certainly no industry requires to have its pick of the best as much as the railways. The railway mechanical departments have never gone into the apprentice question whole-heartedly. To turn a boy loose in a shop and let him gather what knowledge he may, at the rate of 10 or 15 cents an hour is not going to train men who will work up in the organization. If an apprentice is worth putting into the shop, he is worth looking after carefully, and by this we mean all classes of apprentices, whether special or regular.

The average boy is going to be interested in that organization which takes some interest in him. A limited number of roads have established successful apprentice courses, and they have been successful in furnishing good men for the shop. The boy who starts work at an early age must be trained to think, and if a course of instruction is given him outside of shop hours he will prove a more valuable man in later years. It is probably true that the public schools could do more to coöperate with railways and industrial establishments along these lines, but until they do so the railway mechanical departments must do more in training boys for service in shops and elsewhere.

There is no industry in the country which requires such strong, responsible men as the railways. There is no industry which can derive so much benefit by continually training an employee from the moment he enters the service.

RAILWAY MAIL PAY.

Editor, *Railway Master Mechanic:*—In the September issue of the *Railway Master Mechanic* I noticed an article protesting against the policy of the Postoffice Department in not giving the railroads fair treatment in the carrying of the mail, and suggesting writing to Congressmen calling their attention to the injustice suffered by the railroads. I would like to see information given through the *Railway Master Mechanic* as to what the roads do receive for their service. The Socialists tell us that it is 9 cents per pound and that the United States pays rent for each postal car to the value of it each two years, and as the car lasts twenty years it is paid for ten times by the government and still owned by the railroad. Through all the doing of ex-Postmaster General Hitchcock and the second-class mail wrangle I have never found anything that I consider reliable information in the case.

If the railroads were receiving a fair rate of pay before the inauguration of the parcel post, it is bound to be too small now, and if too small before, it must be "then some," to say the least. We can't vote down here, and government employees are not supposed to write to Congressmen, but we would like to know the facts of the case. C. R. PACKARD.

Empire, Canal Zone.

The article referred to above dealt with the injustice to which the railroads were obliged to submit by reason of the practice of the Postoffice Department, of paying for the transportation of mail on an average daily weight established by a quadrennial weighing at the beginning of the period, without any allowance for the natural increase in weight during the four years.

The system of pay for the transportation of mail is exceedingly complicated and it will be impossible in the limited space here available to go fully into all of the details, but an effort will be

made to give sufficient facts to enable one familiar with railroad operation to draw his own conclusions.

The railroad lines are divided by the Postoffice Department into mail routes. Once in four years the mail transported over each route is weighed for a period of 105 days, to determine the average daily weight. The railroads are not allowed any part in this weighing or to check the weights. The railroad is advised that the average daily weight is so many pounds and that for the next four years it will be paid so much for transporting the mail over that route. The compensation varies. The greater the weight of mail carried, the less the pay per pound. The highest rate paid is on the lowest weight in the schedule, which is two hundred pounds, and for which the pay is $42.75 per mile per year. Do not misunderstand this. It does not mean that $42.75 is paid for transporting two hundred pounds of mail one mile one time, but that it must be transported one mile each day for a year to earn that amount. Multiply the number of pounds by 365 and you have the number of pounds that must be transported one mile for the pay mentioned.

As will be explained later, there is no pay for postal cars on a route of this kind.

Take, for example, a route where the mail is fairly heavy. This is an actual route now in operation, being 182 miles long. The average daily weight of mail is 11,956 pounds as determined by the last weighing, and the total compensation to the railroad is $44,000 per year. Therefore, not allowing for the natural increase in weight since the weighing, the number of pounds of mail carried in this route one mile during the course of a year is 794,237,080, and the rate paid per pound per mile is about .000055 cent, or approximately 11 cents per ton. This is far from being one of the heaviest routes, and consequently the rate of pay is not the lowest.

The mail on this route is handled on nine trains—on five of them in baggage cars, and on four in what are known as compartment cars. The railroad does not receive pay for any of these cars.

There are two classes of postal cars in the service. That is, cars which carry postal clerks for sorting mail en route and are fitted with the fixtures necessary therefor and are, in reality, traveling postoffices. One is the full postal car, for which the Postoffice Department pays, in addition to paying for the weight of mail, and the other is the compartment car, for which the railroad receives no pay.

Where less than forty lineal feet of car space is required, the Postoffice Department pays nothing, but where more than forty is required the railroad is paid for each mile run, the rate being determined by the length of the car. For a forty foot car it is .034 cents and for a sixty foot car .055 cents per mile, for such distance as the Postoffice Department may authorize such a car to be used. .055 cents per mile is the highest rate paid, although there are seventy foot cars in service. Postal cars must be constructed and supplied with light, heat, drinking water, etc., as well as all fixtures required for the handling and distribution of mail, all in accordance with the regulations of the department. Such cars cost about twelve thousand dollars each. A car cannot, of course, be operated continuously as there are necessary layovers at each end of the route for unloading, loading and cleaning, and it is not always possible to make close connections for the return trip. It is also necessary that a reserve supply of cars be maintained, to take the place of cars taken out for repairs. The report of the Postmaster General for the year ending June 30, 1913, shows 1,114 full postal cars in service and 274 in reserve. This means that the railroads had invested in those reserve cars $3,288,000 for which they received no return.

If, in a mail route, the mail is heavier in one direction than the other and requires, say west bound, a sixty foot car, but only a forty foot car east bound, the Postoffice Department will pay only the rate for a forty foot car east bound, although it is obvious that the railroad must use the sixty foot car on the return trip. When the interest on the investment, the cost of hauling, repairing, lighting heating and cleaning the cars and of supplying them with ice water, is considered, it is a difficult matter to figure out where the profit is, even at the maximum rate of .055 cents per mile.

Compartment cars, so called, are cars in which the Postoffice Department requires less than forty lineal feet of space. They may be required by the department at will and must be fitted up and maintained at the expense of the railroad, for the handling and distribution of mail en route, the same as a full postal car, but for these cars the railroad receives no pay.

The report of the Postmaster General for 1912 shows that there were 1,388 full postal cars. These would average about fifty feet in length, making a total of 69,499 lineal feet of car space for which the railroads received pay. During the same year there were 4,029 compartment cars, in which an average of about 25 feet was fitted up for postal use, or a total of 100,725 lineal feet of car space for which the railroads received no pay, other than for the weight of the mail carried in them.

Many petty subterfuges are resorted to reduce cost at the expense of the railroads. In some cases, in long routes, full postal cars will be ordered carried to a certain point. Beyond that no pay will be allowed the railroad for them. It must then delay the train and at its own expense transfer the mail to other cars.

Fines from which there is no appeal are imposed for every infraction, however trivial, of the regulations of the Postoffice Department and deducted from the pay of the railroads.

The railroads receive no pay for the transportation of Postoffice Department employes, whether in postal cars or not, while they are traveling on Government business. Conservative estimates have placed the amount of this free transportation, if paid for at regular passenger rates, at considerably over one million dollars per year.

Another feature which is a hardship, is the requirement, that in places where the postoffice is within a quarter of a mile of the depot and at all terminals except where the department chooses to make other arrangements, the railroad must deliver the mail to and from the postoffice without extra pay. There are some small roads where the expense of this has amounted to more than they received from the Government.

The establishment of the parcels post was a severe blow to the railroads. No consideration whatever was given them. This tremendous amount of mail was added with no provision for paying the railroads for carrying it, until the arrival of the next quadrennial weighing which, in some cases, was four years away. The railroads, after a time, did succeed in obtaining from Congress an appropriation of $5,000,000 to be apportioned among the various mail routes by the Postoffice Department, as it should see fit, but in no case to exceed an increase of five per cent. How inadequate this is, may be judged from the article by Postmaster General Burleson in the Saturday Evening Post of Nov. 1, 1913, in which he states that in the first six months after the establishment of the parcels post, 300,000,000 parcels passed through it and that in the second year the total will approximate one billion parcels with a maximum weight of twenty pounds each.

The establishment of the parcels post was without doubt a great benefit to the country in general, as well as a great political move which unfortunately or otherwise failed of its object, but it was done at the expense of the railroads.

The railroads are looked upon by the short sighted as soulless corporations which cannot suffer and as the legitimate prey of whoever can fatten upon them, whereas, in reality, the railroads are, so far as their earnings are concerned, simply clearing houses for their distribution. Nearly all of their earnings are expended for wages of their more than million and a half of employes, and the purchase of supplies, the manufacture of which, affords employment to as many more, the remainder being paid out for taxes and as interest and dividends to the thousands who have invested their savings in stocks and bonds.

The ones who have suffered and who will continue to do so, by reason of the burdens placed upon the railroads by politicians seeking to curry public favor, are railroad employes, those and

their employes who supply railroad necessities, investors in railroad securities and those whose business is dependent upon proper transportation facilities. They are entitled to little sympathy, as it is largely their own fault that the present conditions exist, for they have made no effort to protect their own interests.

Twenty Years Ago This Month

The closing of the World's Columbian Exposition was attended by many changes in equipment facilities among the railways entering Chicago. The Illinois Central let out the work of changing its suburban passenger cars to freight cars by contract.

Enoch Lewis, purchasing agent of the Pennsylvania, ended forty-three years of service by tendering his resignation, to take effect November 30, 1893.

The first trial of electricity, transmitted through the trolley system for the propulsion of the canal boats operating on the Erie Canal, was conducted at Rochester, N. Y., November 18, 1893, by the Westinghouse Electric & Manufacturing Co. and the Niagara Falls Power Co. It may be added that the New York Tribune in its account of the test stated that the boat "was pushed by two trolley poles instead of one as are ordinary street cars."

The special high speed locomotive "Columbia," built by the Baldwin Locomotive Works, and exhibited at the World's Fair, was placed in service, for trial purposes, on the Chicago, Milwaukee & St. Paul. It was a Vauclain compound with two-wheel leading and trailing trucks. The drivers were 84¼ inches in diameter. The English builders of the four-cylinder simple locomotive, "James Toleman," also exhibited at the Fair, were anxious to have a comparative test between the two locomotives mentioned. Their claim was that, with simple cylinders and higher pressure, better steam distribution and larger drivers, it would make a better showing than any American compound. The test was not held.

Abrading wheels made of a new substance called "carborundum" were beginning to be used in railway shops. The substance was explained to be a crystallized combination of silicon and carbon, made by fusing in an electric furnace. The inventor is E. G. Acheson and the manufacturing company was the Carborundum Co., of Monongahela City, Pa.

During November, 1893, nearly all of the larger railway manufacturers went back to full time following the earlier retrenchment; also those railways which had reduced wages temporarily either restored them or made promises as to their early restoration to the original scale.

One of the most notable of railway excursions was the trip of two trains made up of World's Fair exhibits of equipment from Chicago to the East. One of the trains consisted of the famous 999 hauling five elaborate Wagner sleepers and two flat cars on which were loaded the three small cars which composed the first train of the New York Central Ry., run in 1831. The second special train was made up of two English sleepers of the London & Northwestern Ry., two Wagner sleepers and a diner, and was hauled by the London & Northwestern three-cylinder Webb compound. These trains were operated only in the daytime, making stops for inspection at each large city on the line of the Lake Shore and of the New York Central.

The Griffin Wheel Co., of Chicago, was formed to manufacture car wheels. The incorporators were: Thomas A. Griffin, Gardner C. Willard and Wm. W. Evans.

A double end locomotive for Brooklyn Bridge, New York, was delivered by the Baldwin Locomotive Works. This locomotive was used for hauling trains between the hours of 1 a. m. and 5 a. m., while the cable was stopped.

STANDARDIZATION OF FREIGHT CARS.

Editor, *Railway Master Mechanic:* I think we are making fairly rapid strides towards what Mr. Ripley desires, as stated in his recent article on "Standardization of Freight Cars," by reason of the combination of railroad ownership into large systems; but in establishing a standard for a great country like the United States, there is great danger of going to extremes. The Pennsylvania Railroad and its allied lines have recently gotten out standards for box cars, refrigerator cars and the like which in weight of construction far exceed that used by any other line. If their designs are correct, the designs of all other companies are woefully weak.

My own judgment is that the true course lies somewhere between the extremes. Mr. Ripley says that he has to pay $1,400 for a suitable freight car, whereas some companies pay as little as $900. This $500 is a wide difference in price and I am inclined to think that the most efficient car could probably be designed at a cost that would represent a very big saving over the highest cost and perhaps not be very much more expensive than the lower figure named.

Mr. Ripley perhaps does not appreciate to what extent the Master Car Builders' rules have thrown upon the owner of the car all burdens incident to what might be called "cheap and hasty" construction. In old days the user of the car had to pay the most of the damage incident to its use, but in the last ten years this has all been changed.

The problem is a very big one and might well be left to be handled by a commission of men of marked ability. My own judgment is that sometimes a serious mistake is made in the office of some executive who in trying to save something on the price of the car (which, of course, is entirely proper), lets go some important detail of construction. A case came to my attention of some steel underframe cars the center sills of which had been designed by the car department to be made of ⅜" material. When it came to the final letting of the cars and settling down of prices by the manufacturers, the car was let to the lowest bidder, but center sills made of ¼" material were accepted. Some defects in design, coupled to this fatal blunder, resulted in the cars giving out very soon. The center sills buckled in shocks and were not strong enough to take the buffing and pulling strains, and soon had to be reinforced.

There is a good deal to criticise in many of the early designs for steel underframe cars, and it is not unnatural that these early designs were simply carpenter's work done in metal. However, more and more intelligent work is being done in this direction.

After considerable personal experience in car and engine designing, which has been tempered by some other experience, I think that we should go very slowly in the matter of standard cars. It would be perfectly proper, however, to—little by little—come to fix certain standards for draft rigging, for center sills, for body and truck bolsters, for outside clearances; just as standards have already been established for wheels, axles, journals, arch bars, etc.

F. A. Delano, Receiver Wabash Railroad.

Editor, *Railway Master Mechanic:*

Mr. Ripley's treatment of the subject of Standardization of Freight Cars, in the September issue, is so sound and all-embracing that there is little room for further discussion, but inasmuch as your publication deals with technique, permit me to add to his article a suggestion that can be put into practice sooner perhaps than his plan; and it is in relation to the brake rigging on freight cars, which I think could be standardized through the action of the Master Car Builders' Association. There are two things in connection with the brake gear that menace the safety of trains: The first is the bad practice of hanging brake beams to the body of the car. I am almost ashamed to state that this practice is being perpetuated—largely in the West—and I am unable to comprehend the reasons for so odious a practice. The next is the quality of the airbrake

hose. It is no exaggeration to state that the integrity of trains is largely dependent upon the stability of airbrake hose. When one is devised that gives the maximum resistance to the service stress, it should be adopted by all roads—regardless of price. In due time the use of a duly certified hose should be dealt with in the interchange of cars.

While the "millenium," so aptly portrayed in Mr. Ripley's communication, may be distant, I contend that there should be a standard (as to quality) journal bearing and airbrake hose and a standard method of attaching brake gear to the truck instead of to the body of the car. These three things can be entered on at once by the Master Car Builders' rules for the exchange of cars.

F. D. Underwood, President, Erie R. R.

Editor, *Railway Master Mechanic:*

I heartily and completely agree with the attitude taken and the views expressed by Mr. Ripley on standardization of freight cars, in your September issue, with the exception that I am inclined to doubt whether it will be practicable to get the railway companies to act in this matter of their own volition; and, if I am right in so thinking, I believe that it would not be amiss for the Interstate Commerce Commission to take a hand in the standardization, and require the railways to build standard cars, just as it requires railways to comply with the minor safety appliances connected with the cars.

Raymond DuPuy, V. P. and G. M.,
Virginian Railway.

FREIGHT CAR TROUBLES.

Editor, *Railway Master Mechanic:* It has been the practice on our road to scrap 30,000 and 40,000 capacity box cars when they require a general rebuild. We are not doing anything towards the introduction of strengthening light capacity cars for the reason that the light capacity car is very unpopular with shippers, and our traffic department is placed at a disadvantage offering light capacity cars for loading on account of the reduced loading space as compared with the modern box car. We believe that this is a question on which the traffic departments should be consulted and I am sure, after careful canvass of the officials of the traffic departments you will find the consensus of opinion is that light capacity box cars should not be continued in interchange service.

J. Coleman, Supt. Car. Dept., Grand Trunk Ry.

Editor, *Railway Master Mechanic:* With regard to the article on "Freight Car Troubles," which appeared in the October issue of the *Railway Master Mechanic,* written by Mr. J. C. Fritts, master car builder of the Delaware, Lackawanna & Western, I, for one, agree with Mr. Fritts on his discussion, by my experience with the short wooden drafts. The Washington Coal & Coke Company has now two hundred and ninety-five cars of 60,000 pounds capacity, which were formerly equipped with the short wooden drafts, and they were continually giving trouble with draft bolts breaking, drafts, end sills, center sills and couplers pulling out, and drafts working backward and forward four to five inches at times, allowing the air hose to cut enough to apply the air brakes, and thereby delay the train.

Almost any draft of this construction will give similar trouble. Very often while making a coupling, the end of the car breaks down, and this makes it very unsafe for trainmen and liable to incur damage suits. Not two years since the Washington Run Railroad Company had a wreck on its line caused by the short wooden drafts dropping down. This wreck cost the above company several hundred dollars for repairs to the damaged cars.

During the last four years the W. C. & C. Co., has done away with the wooden drafts. It was found that to equip the cars with steel underframes would be more expense than was really advisable to put on old cars, so they decided to equip them with an open cast steel body bolster, and the Stickel cast steel draft arms. These draft arms extend from the end sill back through the body bolster three feet six and five-eighths inches. By this arrangement the center sills are supported, and also the end of the car, and the coupler is always carried up to the standard height. These draft arms are locked to the top flanges of the body bolster, which makes them perfectly stationary, not allowing them to work backward and forward as the wooden drafts frequently do. This protects the draft bolts, and by these drafts extending through the body bolster it keeps them from spreading. The use of a draft of this construction makes it safe for trainmen while making a coupling, and these cars can be placed in with any heavy train, and makes it more convenient to inspectors.

The first car I equipped was one of the W. C. & C. Co. cars five years ago last April, and I have yet to replace the first draft bolt since that time, and that is saying a good bit for drafts on wooden cars. While the cars were still equipped with the old wooden draft timbers, it was formerly a usual occurrence to get ten to twenty shop cars, shopped for draft bolts. The Stickel draft arms can be made to suit any draft gear, or can be made to be riveted on steel centers.

H. C. Stickel,
Car Foreman, Washington Coal & Coke Co.,
Star Junction, Pa.

STEEL AND STEEL UNDERFRAME Box Cars will be the topic for discussion at a railway session of the American Society of Mechanical Engineers, to be held in New York probably on December 3. W. F. Keisel, Jr., of the Pennsylvania, will present a paper on All Steel Box Cars and discussions on this topic have been asked from E. O. Chenoweth, R. B. Kendig and B. D. Lockwood. A paper on Steel Underframe Box Cars will be presented by R. W. Burnett of the Canadian Pacific and discussions of this subject have been asked from G. W. Rink, O. C. Cromwell and A. Christiansen.

THE VALUATION of the physical properties of the railways of the United States is to be accomplished by a special board under the jurisdiction of the Interstate Commerce Commission. Charles A. Prouty retires as a member of the Commission to become director of this work. The country will be divided into five districts, each district to contain about 50,000 miles of road. The districts, together with the headquarters of each, are: Eastern, Washington, D. C.; Southern, Chattanooga, Tenn.; Central, Chicago, Ill.; Western, Kansas City, Mo.; Pacific, San Francisco, Cal. Each district will be in charge of a member of the valuation board and a local engineer.

TRYING.

What matters the thing you have failed to do?
The breeze is cool and the skies are blue,
The streamlets sing and the plains are wide—
What matters it that you failed? You tried.
You tried to do it and failed, that's all;
You tried to climb and you had a fall;
There yet are prizes for you to win,
And there's fight in you. Sail in! Sail in!

What matters the goal you have failed to make?
Pass up the grieving, forget the ache;
The winds are cool and the skies are blue,
And those who loved you believe in you;
And there are goals you may yet attain,
And there are heights that you yet may gain:
Go to it laughing and eager eyed!
The men who fail are the men who tried.

The men who fail are the men who went
At a thing worth doing till they were spent;
And it wasn't failure. You'll try again
And you will win to the goal, and then
You will see how deep are the skies and blue
When the ones you love shall be proud of you,
And what will your failure be to you then?
Men never fail who dare try again.

—*Houston Post.*

Decatur Shops, Wabash R. R.

The shops of the Wabash Railroad at Springfield, Ill., are among the oldest in the country, the first buildings being erected about 1852, and the main shops of the system have been located at this point since that time. The men who built these shops could hardly have foreseen the growth which the Wabash and our other railways have attained and the shops have for some time been inadequate to handle the work which devolves on the main shops of a road having over seven hundred locomotives and 2,515 miles of track. Then, too, the growth of the road has resulted in the development of main lines which do not pass through Springfield and consequently the shops at this point are not centrally located.

Springfield is on the main line of the Wabash from Kansas City to Toledo and points east, which line runs in a general east and west direction across Illinois. Another main line of this road runs in a southwesterly direction across the state from Chicago to St. Louis. These two lines intersect near the center of the state at Decatur, Ill., a point 173 miles from Chicago and 113 miles from St. Louis. It is also 339 miles from Kansas City and 323 miles from Toledo. As the old shops were unable to handle the work, owing to their age and design and were not conviently located, it was decided to build new shops, and Decatur was chosen as being the most central location on the system, as pointed out above. About six years ago car shops were constructed at this point as the first step, and something over a year ago it was decided to complete the project by the addition of a locomotive shop, smith shop and storehouse. These are now in operation.

Before setting out to design these buildings, E. F. Needham, superintendent of motive power, and H. P. Anderson, mechanical engineer, made a trip, visiting practically all the large and well designed shops in the country with a view of determining the best type of shop and picking up pointers. After a careful study a shop of the longitudinal type was decided upon, housing also the tank shop, tin shop and boiler shop. The smaller amount of money invested was one of the principal reasons for the adoption of the longitudinal type of building.

The new buildings are located at the edge of town near one or two large manufacturing concerns. The street car line does not come nearer than six blocks, but it is soon to be extended, and the shops will then be about a ten-minute ride from the center of town. The location is rather low and some filling in had to be done. Some trouble with water was experienced in the pits for the foundations of the heavier machine tools. The buildings consist of a locomotive shop 1,118 feet long by 160 feet wide, a smith shop 300′x100′, a store house 306′x100′, two lavatories and an iron storage shed. Eighteen hundred tons of structural steel were used in the main shop and 400 tons in the smith shop, so it may be seen that the locomotive shop building is one of the largest in the country. The walls of all buildings are of brick.

Locomotive Erecting Shop at Decatur, Looking West. Note the "Bay Windows" Above the Balcony.

Locomotive Shop.

"Let there be light" is the slogan in most shop buildings constructed now-days, but never-the-less special emphasis must be placed on the well-lighted appearance of this shop. This is the first thing which draws your attention when you enter it and there are two features which contribute towards this appearance. Beginning at a point about ten feet above the floor, everything in the building is painted white, including every piece of structural steel, the roof interior and the cranes, with the exception of their traveling carriages. Then the construction of the first clere-story is such as to admit a maximum amount of light and to provide for a diffusion of same. This clere-story, instead of being one straight line of windows, is broken up by "dog-houses" at every other panel. This form of construction is probably most easily understood by referring to the illustrations. These "dog-houses" almost double the amount of glass in the clere-story and not only do they serve to throw more light into the main shop, at the same time giving it greater diffusion, but they give a great deal of light to the 500 foot balcony which runs along the south side of the shop. Wooden window sashes are used throughout this building and also in the smith shop and store house. Aside from the window sashes the only wood used in the locomotive shop is the roof and the maple wood balcony floor. The roof is covered with Carey composition roofing, and has a pitch of ¾" in 12".

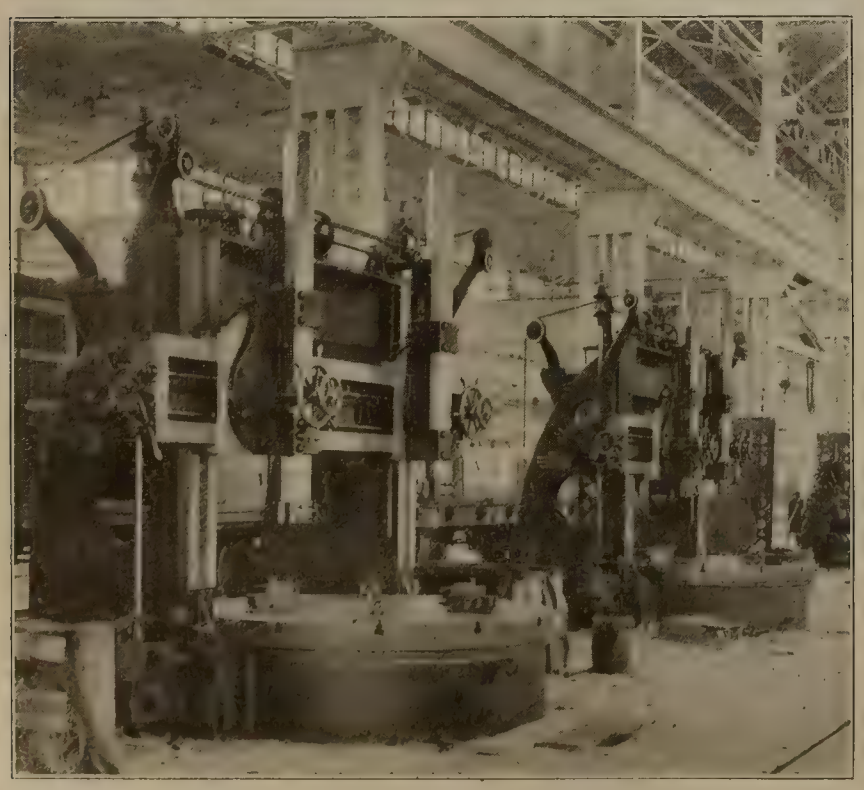
Locomotive Erecting Shop at Decatur, Looking West. At the left the Storehouse and Beyond it the Smith Shop. The Stacks at the Right Belong to a Nearby Manufacturing Plant.

The locomotive shop runs east and west, and the smith shop, storehouse and minor buildings are ranged in a line just north of this building. As the relation of these buildings to each other is quite simple, no illustration of the layout is shown. The illustration of the plan of the locomotive shop indicates that the location of the various departments and the machine tools was very carefully thought out. In general, the first half of the south bay is covered with a balcony on which are located the offices of the shop superintendent, the air brake testing rack, tool room, etc. Under the balcony are the lighter machine tools and the general foreman's office. The air compressors are located on the main floor just at the end of the balcony, and the remainder of the lay is occupied with the paint, carpenter, tank, and flue shops. Directly opposite, in the other bay, is the boiler shop and the foreman's office. The remainder of the north bay is devoted to general machine work. This north machine bay is served by two ten ton cranes and the flue and tank shop is served with one twenty ton crane. In the center of the shop are two 75 ton cranes, having a 90 foot span, and running about 208 feet per minute. Whiting cranes are used throughout.

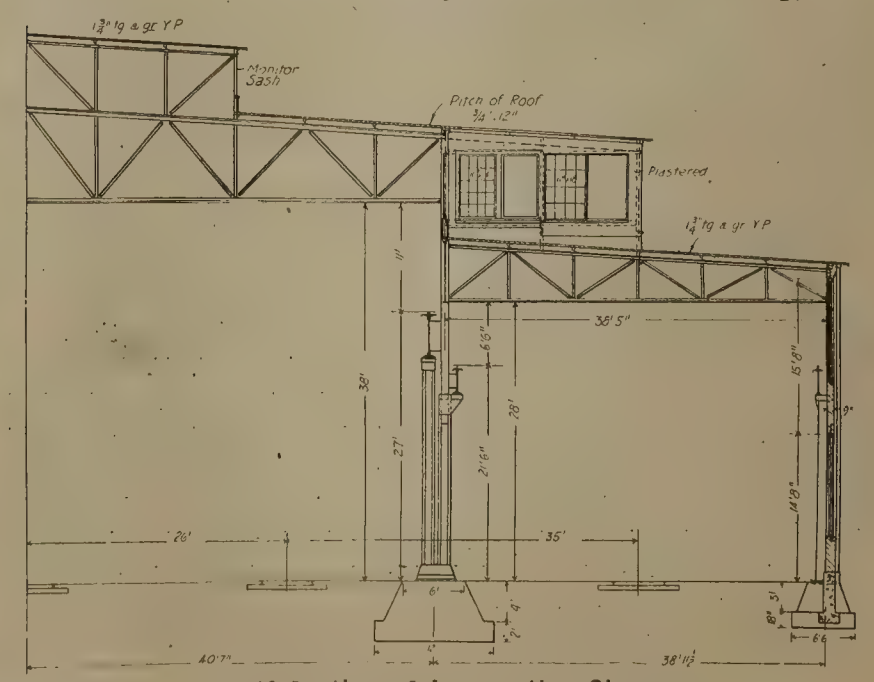
Three standard gauge tracks run the length of the building, and the tank shop and machine departments are supplied with narrow gauge tracks. The center pits at the receiving (east) end, are each supplied with steam and water connections on one side, and air and electricity on the other. These connections are recessed as may be seen by referring to the illustration, making them secure against ordinary accidents. Another interesting feature of these pits is that the first three, which are used for stripping, are separated at the bottom by a concrete wall about ten inches high. The floor of each pit between these separating bridges slopes to a drain at the center and the water from one pit does not flow over into the adjoining one.

Under the balcony in the south bay at this end are located the tools for general machine work, among which are a number of the latest type of geared head lathes which are started, stopped and reversed by means of a lever on the machine. They are located directly under the line shaft and drive straight down. Group drive is used on the lighter machines under, and in the balcony, the motors being mounted on neat sheet iron brackets, as very clearly shown in one of the photographic reproductions. This illustration also shows the method of attaching the line shafts. All line shafts are mounted on structural steel shapes, which in turn are fastened to the girders. The absence of jar and vibration due to this arrangement is quite apparent. In connection with line shafts a valuable arrangement has been made for taking care of motor troubles and breakdowns. While the shaft is broken at frequent intervals and each section is driven by its own motor, the shafts are all in line and can be made continuous by means of simple clamp couplings. The motors are rated so that they may carry a heavy overload for limited periods, and in the event of a motor being put out of commission its shaft can be quickly coupled up to the adjoining shaft and the work proceeds while repairs are being made. The importance of this in preventing the loss of workers' time and in delaying schedules can be readily appreciated.

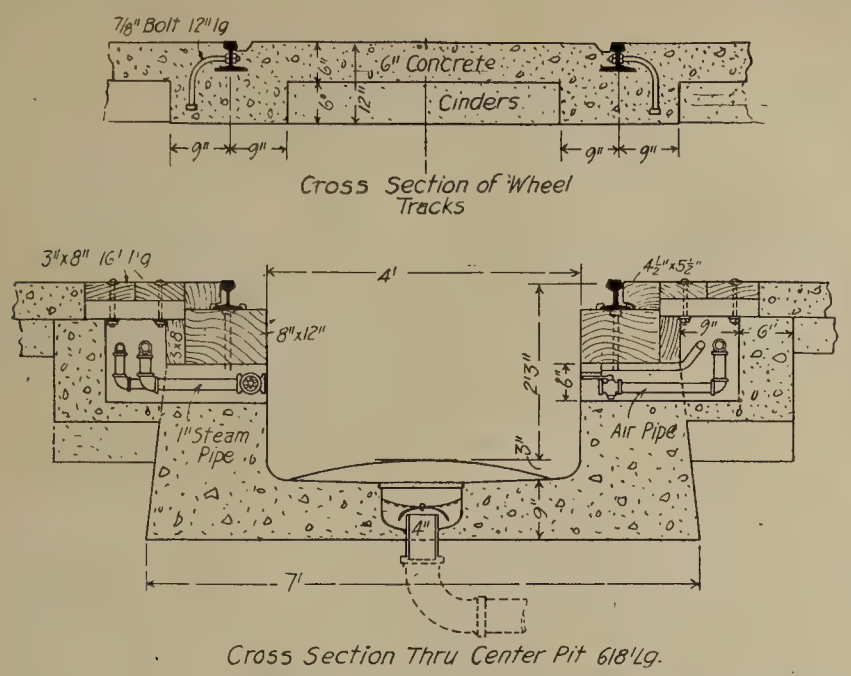
Next in order in this bay is the machine shop distributing tool room, 19'x88', and just above it in the balcony is the manufacturing tool room. The two are connected by a dumb waiter. There is also a distributing tool room in the boiler shop in the northwest corner. These tool rooms have partitions of No. 16 sheet steel to a height of 4½', a No. 13 wire screen, 1" mesh, extending from the sheet steel to the top. Adjoining this machine shop distributing tool room is the general foreman's office. Next are the air compressors, mention of which will be made later. Occupying the southwest corner of this south bay is the tank and flue shop, from



A Group of Machine Tools, Decatur Shops.



Half Section of Locomotive Shop.



Sections, Showing Also Steam, Water, Air and Electric Connections at Pits.

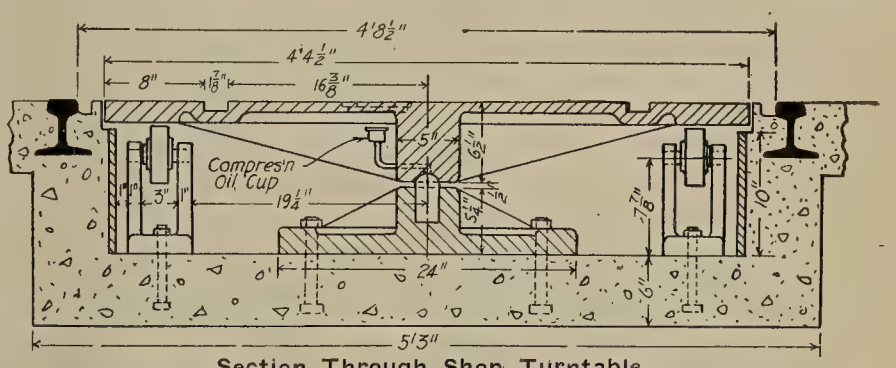
which a narrow-gauge track passes through a doorway in the south wall to the flue rattler outside, mention of which will be made further on. The concrete floors between the crosswise tracks in the tank shop are noticeably "dished" and have a drainage to a covered gutter in the floor running alongside the center tracks. As a matter of fact the concrete floors throughout the shop, wherever necessary, are sloped to form a natural drainage. Over in the north bay, just across from the flue shop, is the boiler shop. Now, there are no pipes following the structural work across the main bay of the shop, but of course it was necessary to provide a blower for both flue and boiler shop forges. So a structural shape about three feet wide was built between the last two posts on the flue shop side at a height of about fifteen feet, and the blower was mounted thereon, as shown in the illustration. The pipes to the flue shop and boiler shop forges were carried along the end of the building. This saved space and put the pipes where they were not an obstruction.

The boiler shop in the north bay has at a point some distance from the end of the shop, a brick lean-to which houses the annealing furnace and the accumulator. This lean-to has a roof com-

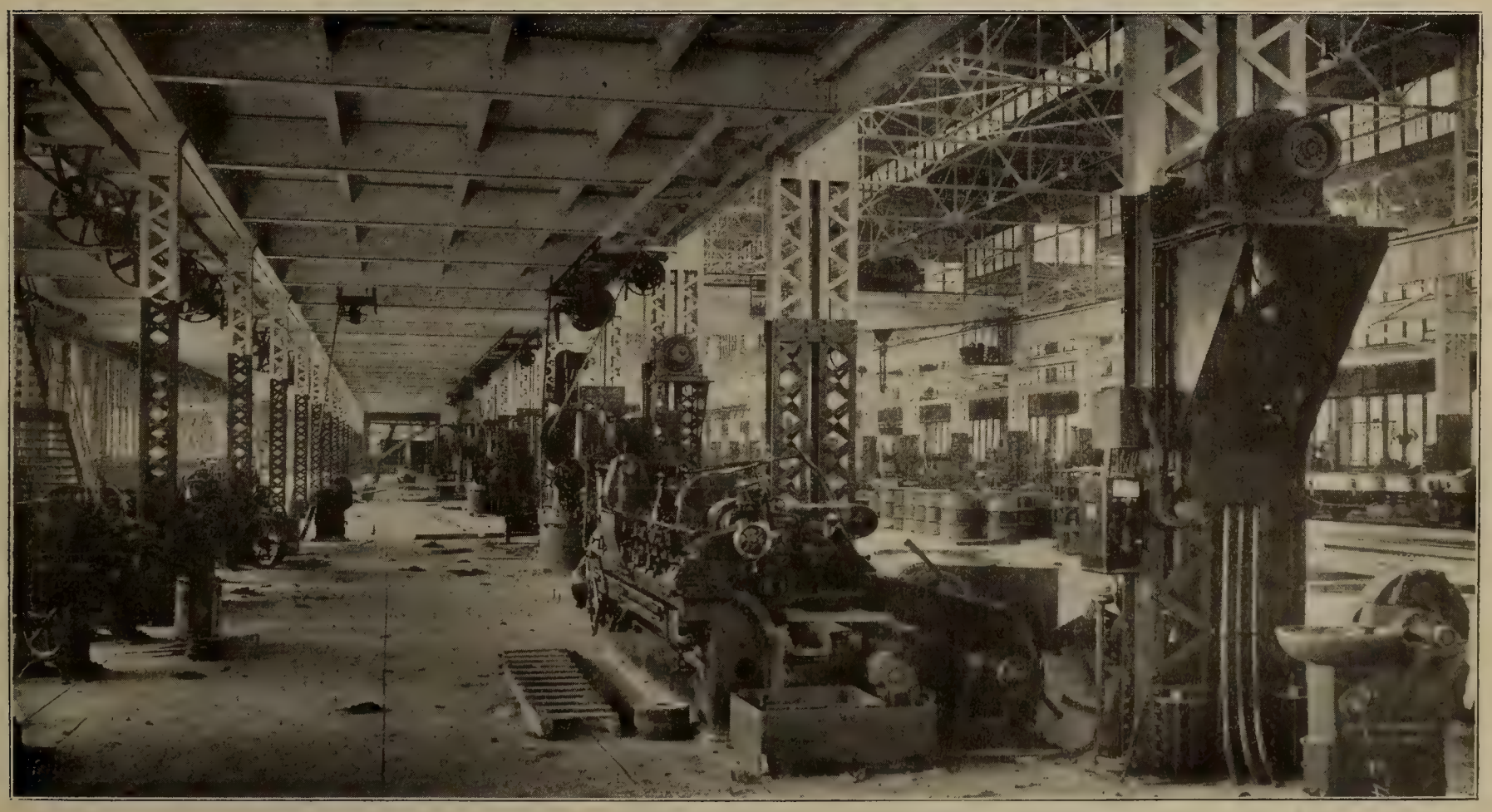
Showing Location of Blower and Piping for Boiler and Flue Forges (see description).

posed of 4" reinforced concrete slabs. There is also a space here which for the present will be used for storing dies. Nearby in the north bay proper are the flanging presses and, further on, the foreman's office. Following in order in this bay are the engine trucks and driver wheel tracks and the machine group for rods, cylinders, driving boxes, crank pins, axles and tires. Narrow gauge tracks also lead to the smith shop and the storage racks, just outside.

The balcony over the south bay contains, in order, the brass work, air pump testing rack, electrical work, turret lathes, manufacturing tool room, superintendent's office, jacket and tin shop. The balcony railing is formed by the steam, air and water lines, together with a low board railing below them. In addition to the dumb waiter from the manufacturing tool room to the dis-



Section Through Shop Turntable.



Under the Balcony. Note Hanging of the Line Shafts and the Bracket for the Motor.

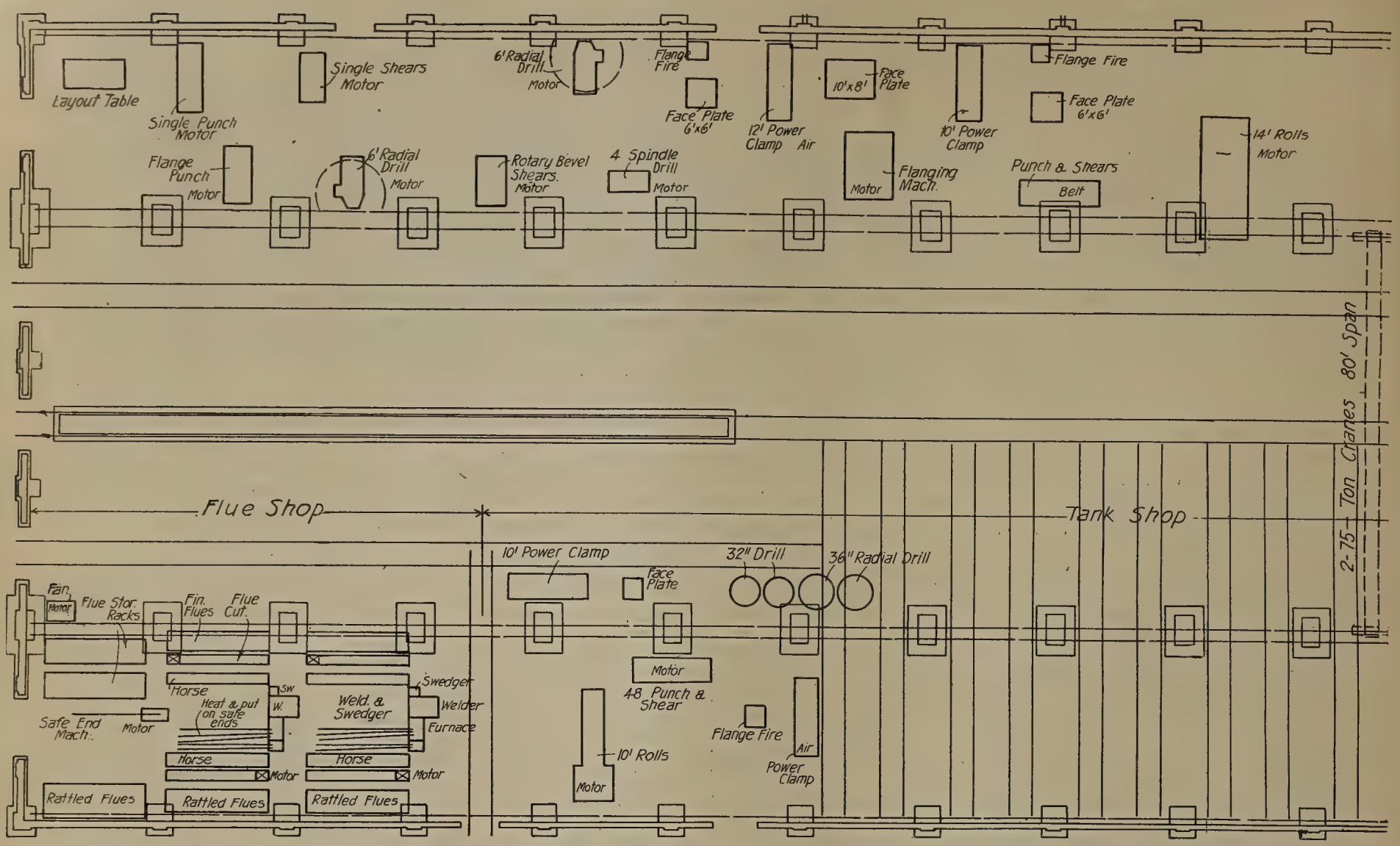


Fig. 1.—Plan of West End of Locomotive Shop.

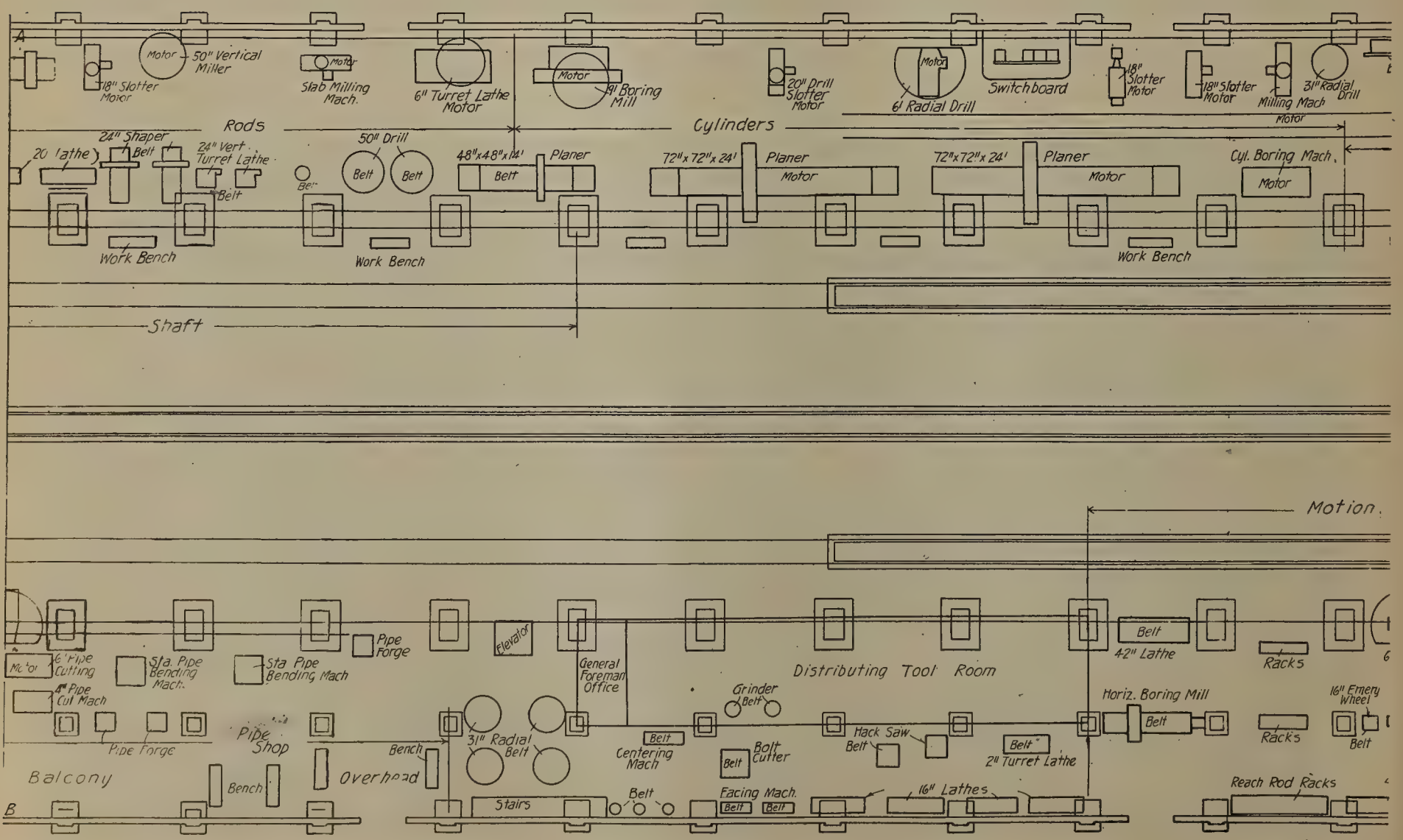


Fig. 3. Plan of Locomotive Shop. Continued from Fig. 2.

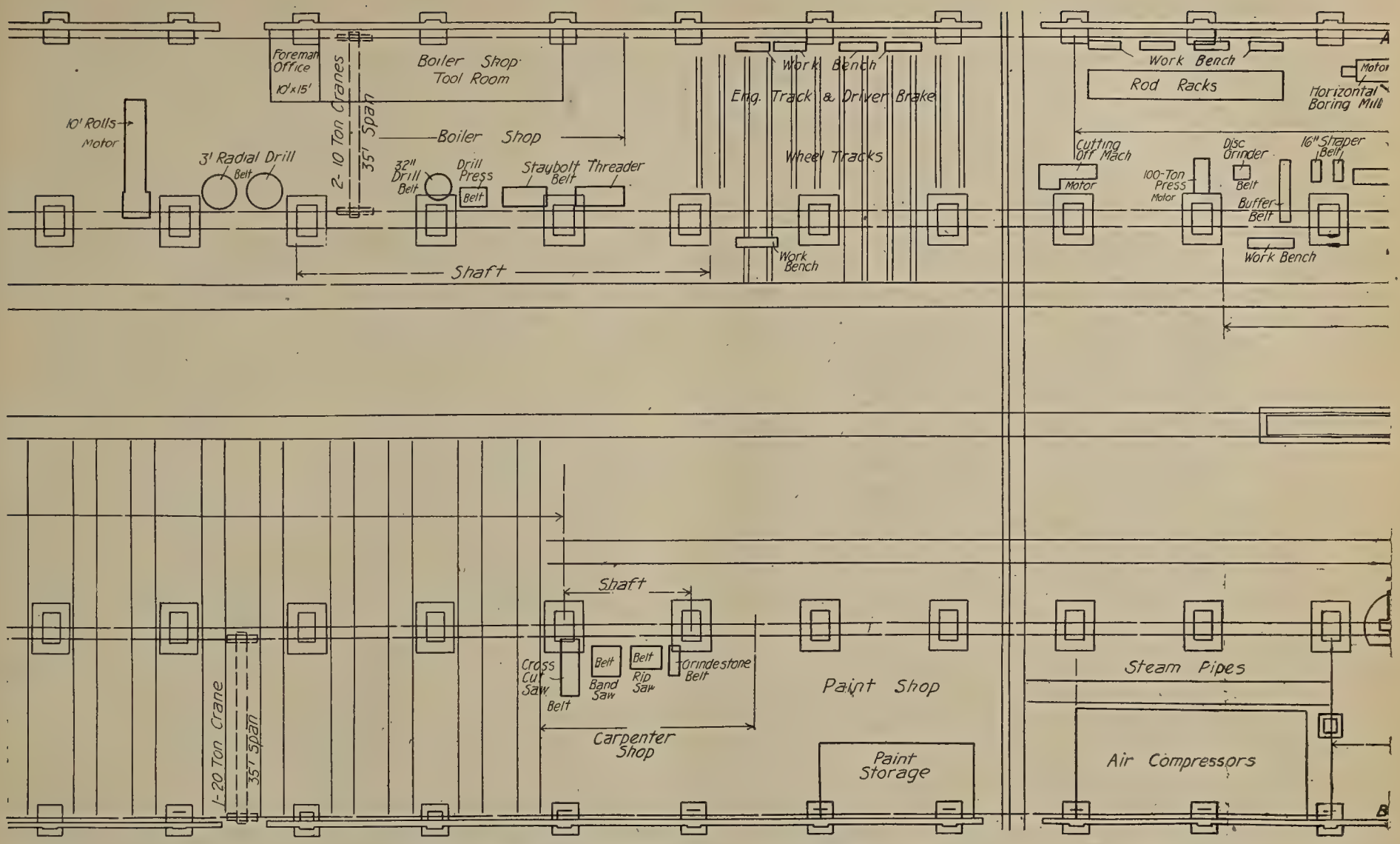


Fig. 2. Plan of Locomotive Shop. Continued from Fig. 1.

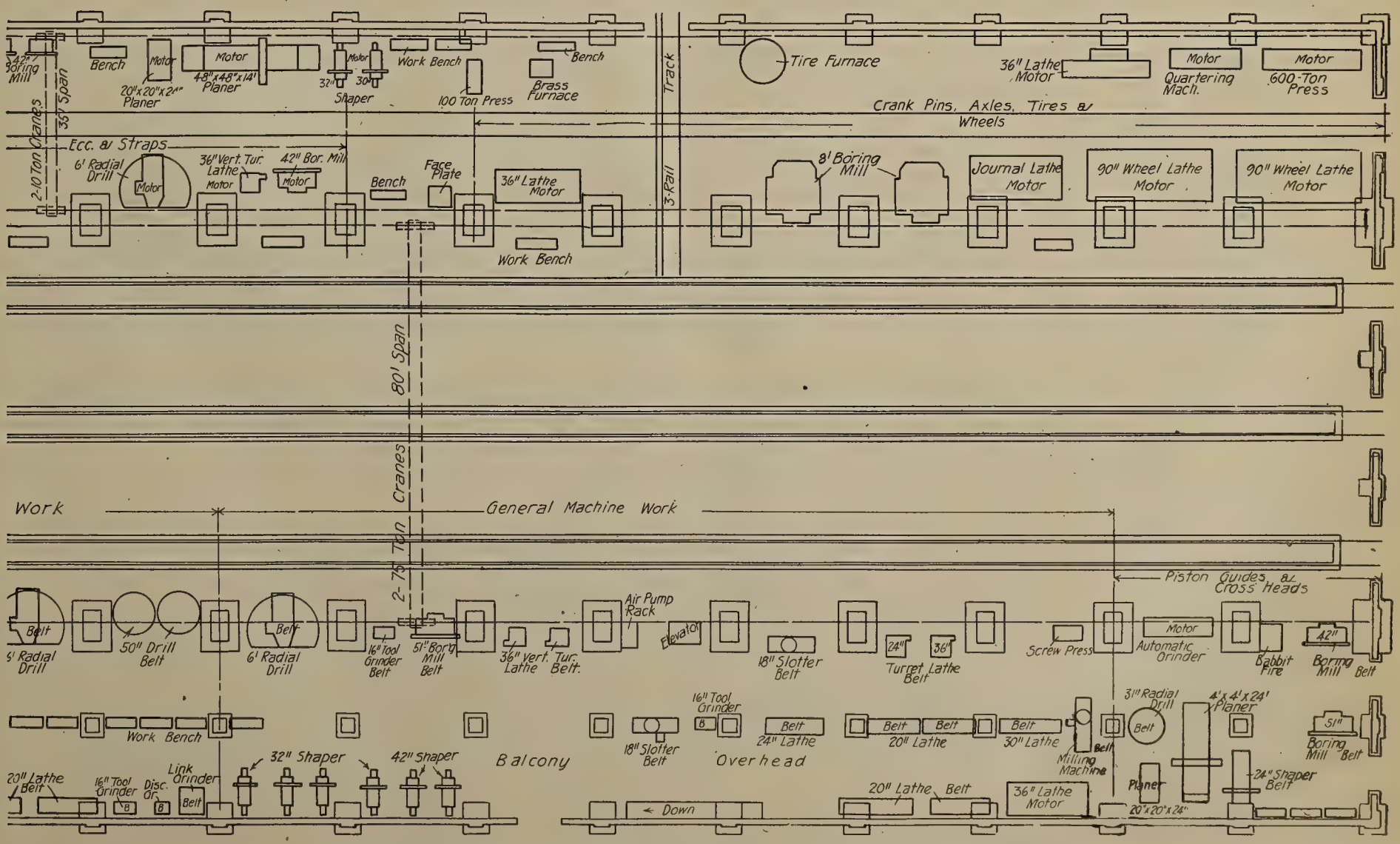
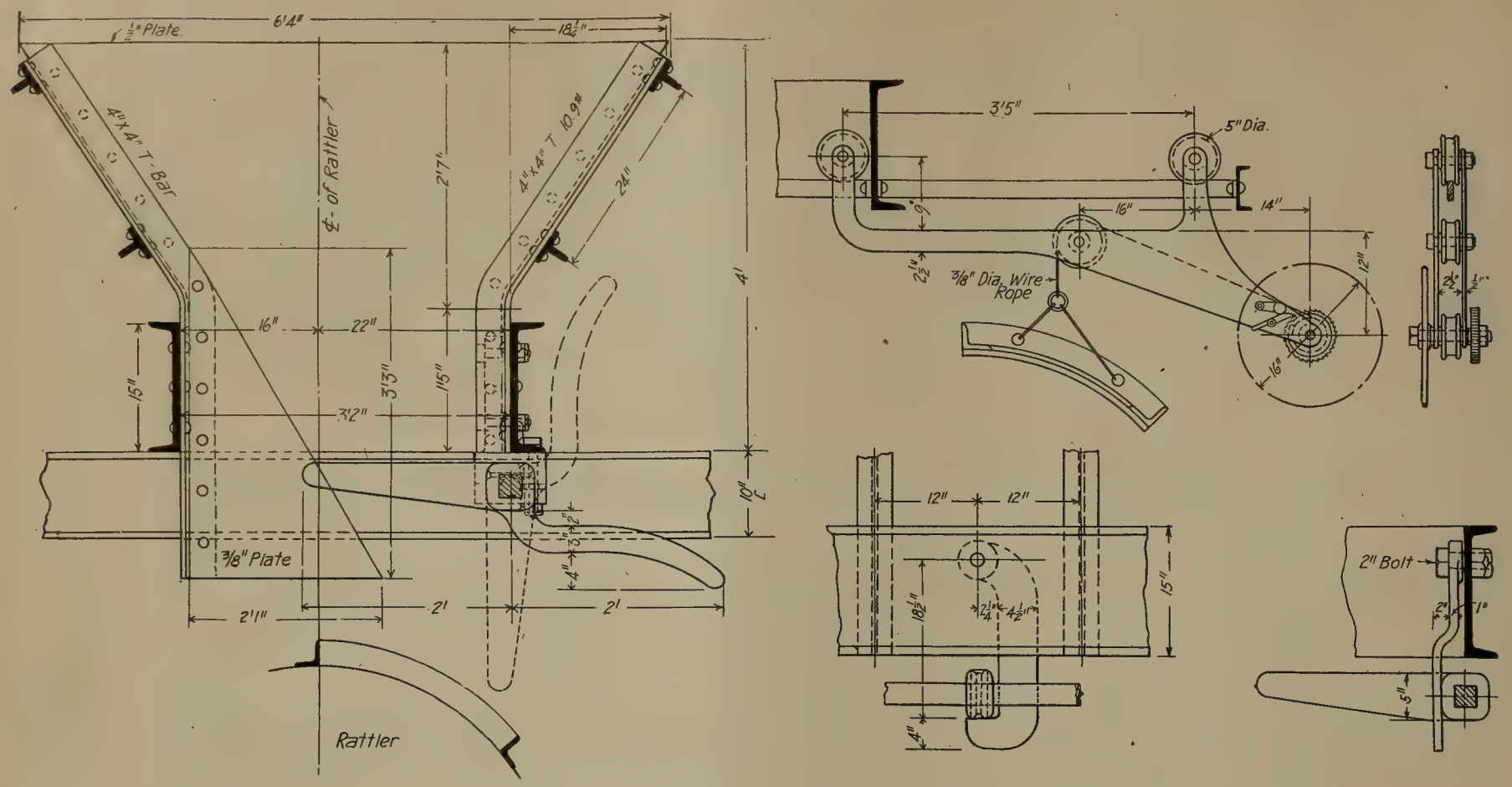


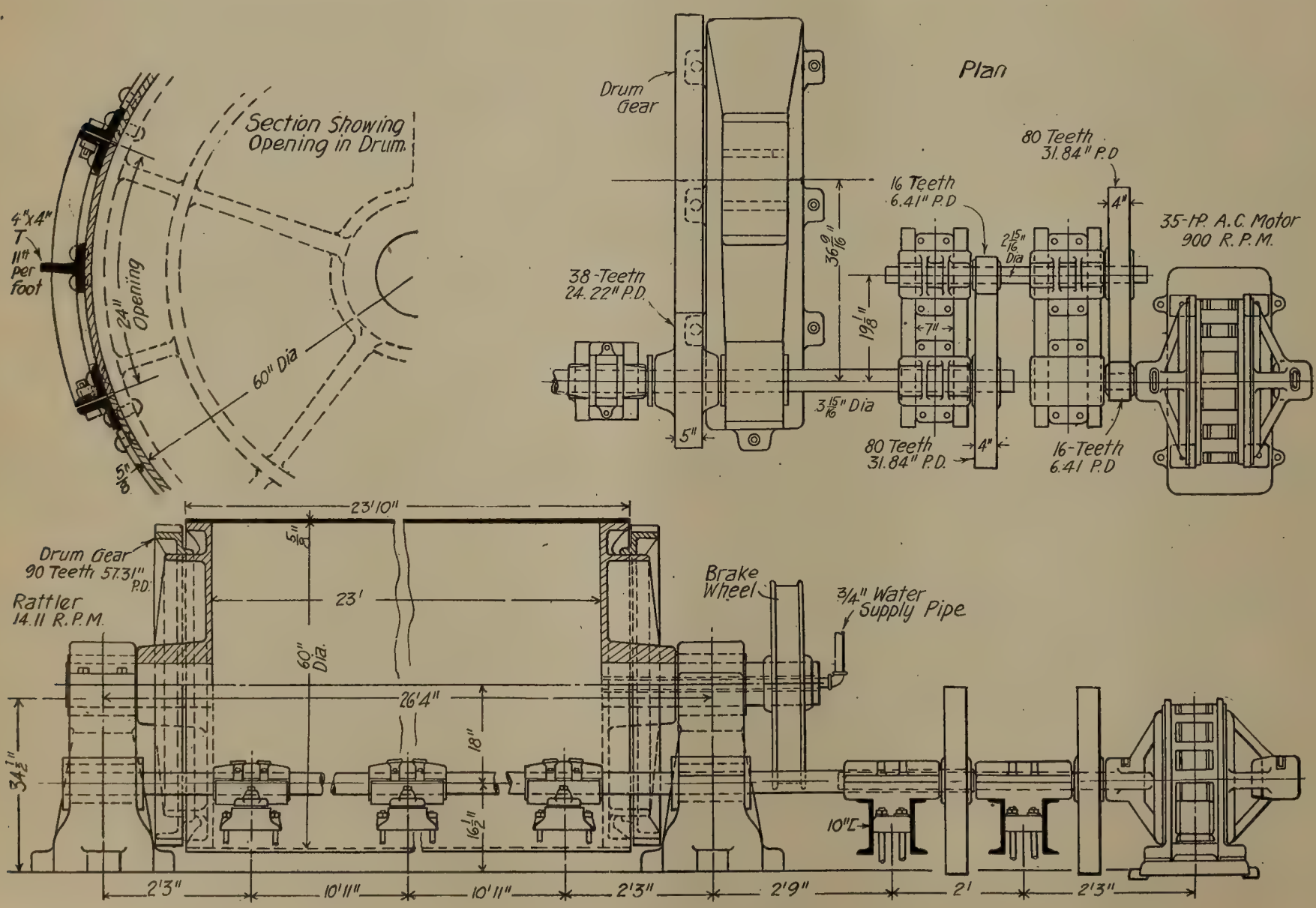
Fig. 4. Plan of East End of Locom otive Shop. Continued from Fig. 3.



Details of Rattler Hopper and Cover Lifting Device.

tributing tool room below there are two electric elevators and two stairways. On the air pump testing rack connections are provided for sending the exhaust of the pumps into the heating mains, and provision has been made for sending the air made in testing the pumps back into the air line. The methods with regard to hanging the line shafts and providing means of making them continuous are the same here as elsewhere in the shop. The offices are roomy and well lighted, consisting of a general office and a private office for the superintendent.

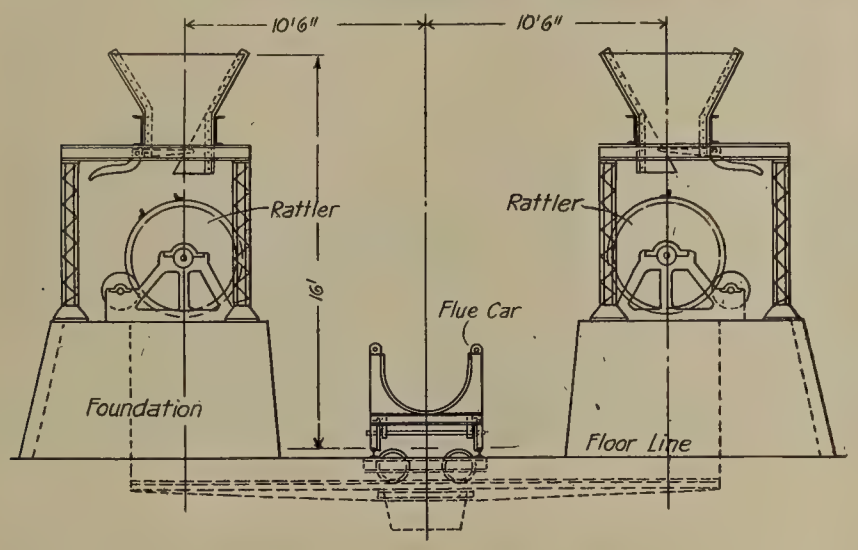
Practically every tool in the locomotive shop is new, and all makes are represented. Some of the tools were brought from Springfield, but they had only been in use about a year at that point, so are practically new tools. The mechanical department held the position that the best was the cheapest in the end, and the shop



Plan and Elevation of Rattler.

contains the best tools that could be bought. The heavier tools are driven by individual motors. Quite a number of special machines designed and in use at the Springfield shop have also been installed, which goes to show that very often the old and poorly equipped shops do more along the line of devising machines for special needs than the up-to-the-minute shops. It is to be hoped that the new Decatur shops will not curtail work of this sort on the Wabash.

Just outside of the east end of the shop is the lye vat, which is 8'x10' by 3'8" deep. In each of the corners and at both ends are concrete blocks 8" high, on which are set pieces of old rails. Entering the pit is a 3" cast iron drain pipe, a 2" water pipe and a 1½" water pipe. The vat is surrounded by a concrete platform 17'x60' which has a slope towards a drain at one side. A special feature at this end of the building, near the lye vat, is a depressed stub end track. This of course has a concrete retaining wall along the sides and at the end. A flat car backed in here will be on a level with the platform and can be used to carry away refuse and scrap.



General Arrangement of Rattlers.

Flue Rattler.

The flue rattler, located just outside the tank and flue shop, was designed by the mechanical department and deserves special mention. As may be noted in the illustrations, it is a double rattler, the two drums being mounted opposite each other. The drums are 60" in inside diameter and 23 feet long, with a 24" opening for inserting the flues. They are driven by 35 H. P. motors running at 900 R. P. M. geared to the drums, which run at 14.11 R. P. M. For draining the drums there are twelve 1" holes equally spaced around the circumference and twenty-two holes equally spaced longitudinally, water being supplied by a ¾" pipe.

Above the drum is placed a rattler loading device or hopper. When the drum is revolved so that the opening is below the hopper, a hook is pulled out which releases the arms at the bottom of the hopper. When these arms are thrown down they serve to guide the flues into the hopper. On the framing below the hopper is a movable apparatus for dropping the cover in place, consisting of a hand wheel, ratchet and ⅜" wire rope. This rope can be attached to a ring which is connected by other wires to a 4"x4" T bar in the center of the cover.

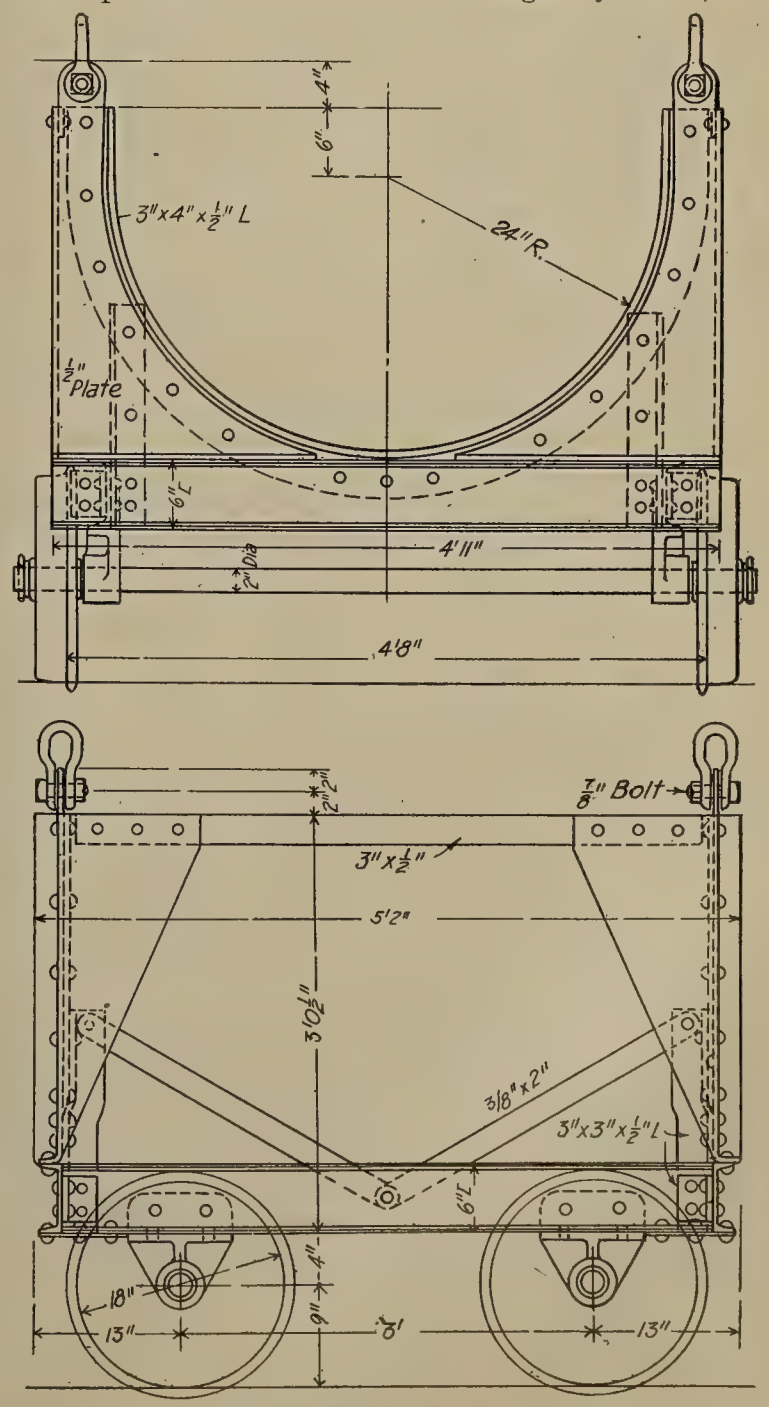
It will be noted that the rattlers are set up on high concrete bases. To place the flues in the rattler hoppers an Ohio locomotive crane is used. The flues are run out of the flue shop on the narrow gauge car to the rattler, where the crane picks them up and drops them in the hopper. In the depressed pit between the two rattlers is a flue pit car which simply runs from one rattler to the other. On top of this car and crosswise to the direction of its travel is laid a track made of 60-pound rails. At the center of the pit these rails line up with the flue car track. The flue car can then be run onto the flue pit car and the pit car then rolled under whichever rattler is ready to unload. The locomotive crane when not in use here is used in the lumber yard and elsewhere, and it is expected that flues will be handled in these rattlers at a very low cost.

Smith Shop.

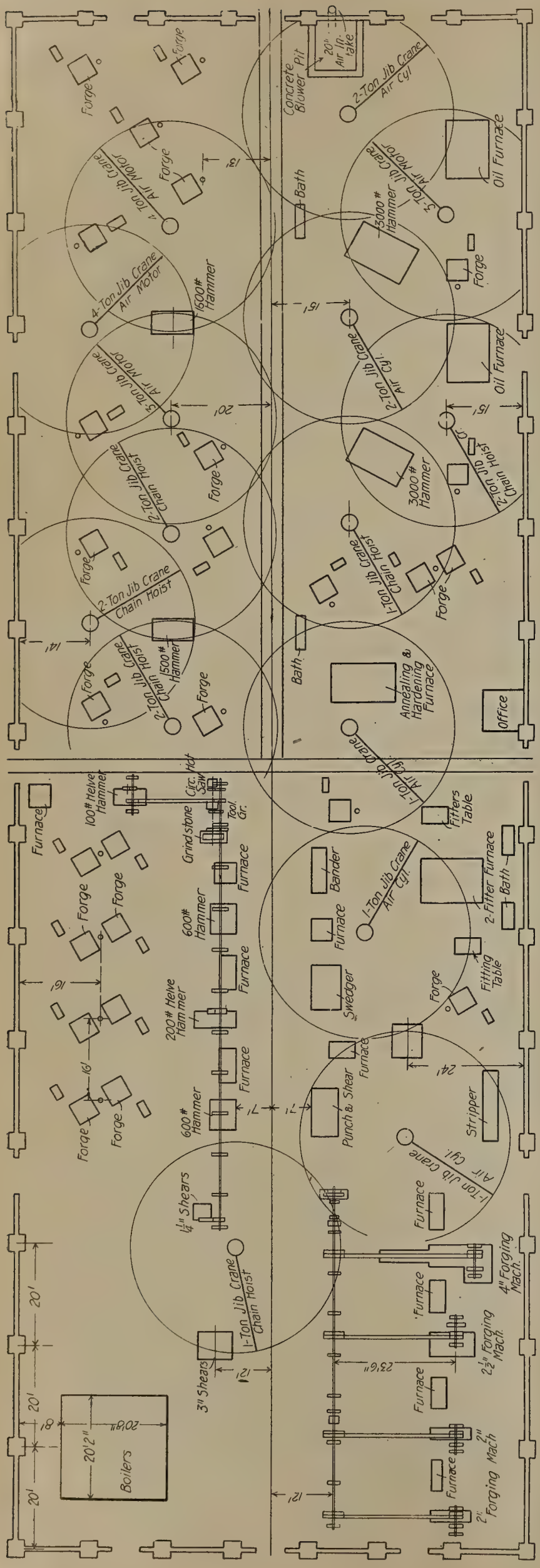
The plan of the smith shop shows that all the space is very effectively covered by cranes. There are fifteen Curtis & Co. 4,000-pound radial cranes, most of which are equipped with triplex blocks. Three of the cranes, however, are supplied with Dake hoists. For some reason the structural work and interior of the roof are painted white. Possibly there was paint left over from the locomotive shop. When the writer visited the shop it had only been in operation four days. American Shop Equipment forges are used throughout. Aside from the efficient crane service, the only other interesting feature in this shop is the blower, which is placed below the floor, in a 8'x9' concrete pit at the east end of the shop, thus effecting a saving in floor space. This pit is next to the outside wall, and air is taken from outside through a 20" pipe of ⅛" sheet iron which passes through the wall and rises vertically outside to a height of six feet. The supply pipe from the blower to the forges is a 30" clay pipe which passes underneath, down through the center of the shop, with branches as required.

Storehouse.

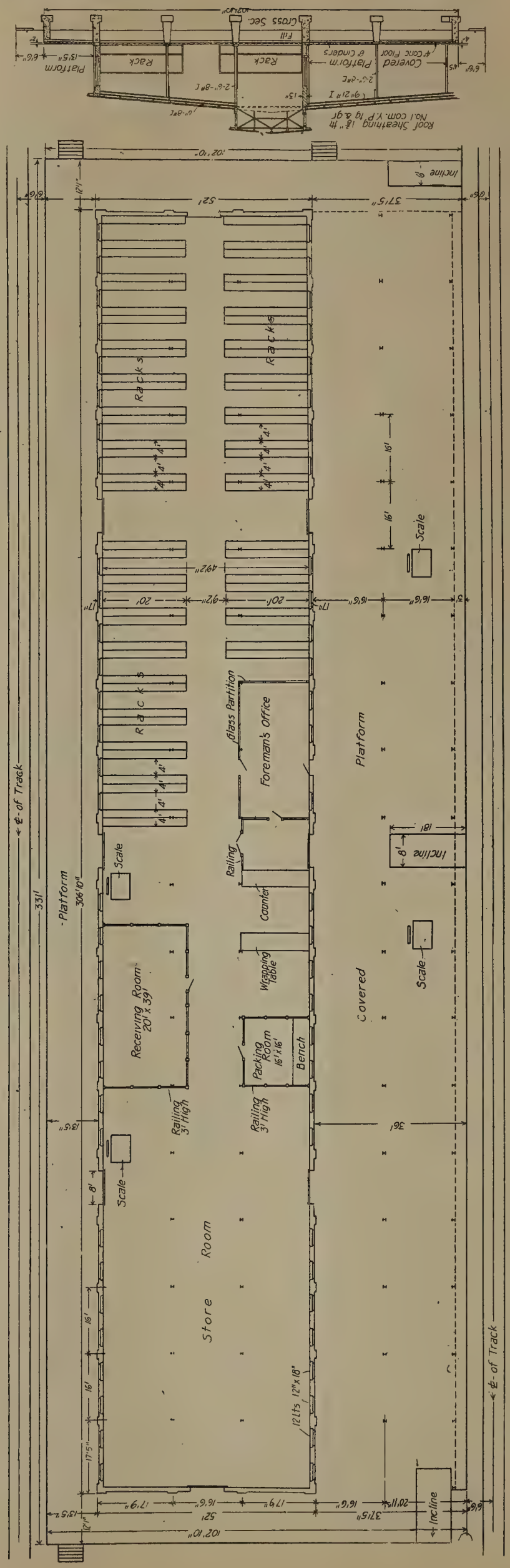
The plan of the storehouse is shown in the illustration. It is a steel and brick one-story structure 306'x100', with a loading platform along one side and a large covered platform along the side facing the locomotive shop, this covered platform perhaps being the most noteworthy feature. Platforms, of course, are of concrete and have a number of sloping approaches. Folding doors are used, each door being in two sections, the upper and lower halves being hinged together at a height of about four feet. They are opened by means of a wheel, chain and counterbalances, and fold together much like a hinge. This type of door leaves a free wall space and will not become damaged by trucks, as it is



Flue Car for Rattler.



Plan of Smith Shop at Decatur.



Plan and Cross Section of Storehouse at Decatur.

Interior of the Smith Shop. Note Structural Form on Which Line Shaft Is Hung.

up out of the way when open. The building contains an office in the center and it is in keeping with the other buildings.

Near by the storehouse is a concrete pit, 18'x38', containing the oil tanks. It is covered with a wood composition roof which, of course, has a scuttle. It contains three tanks, two large ones and a smaller one placed crosswise at the end. The two larger tanks are not under pressure, and the oil is run into them direct from the tank cars. It is planned to keep only the small tanks under pressure. There is a 4" drain to the sewer from the pit.

Other Buildings.

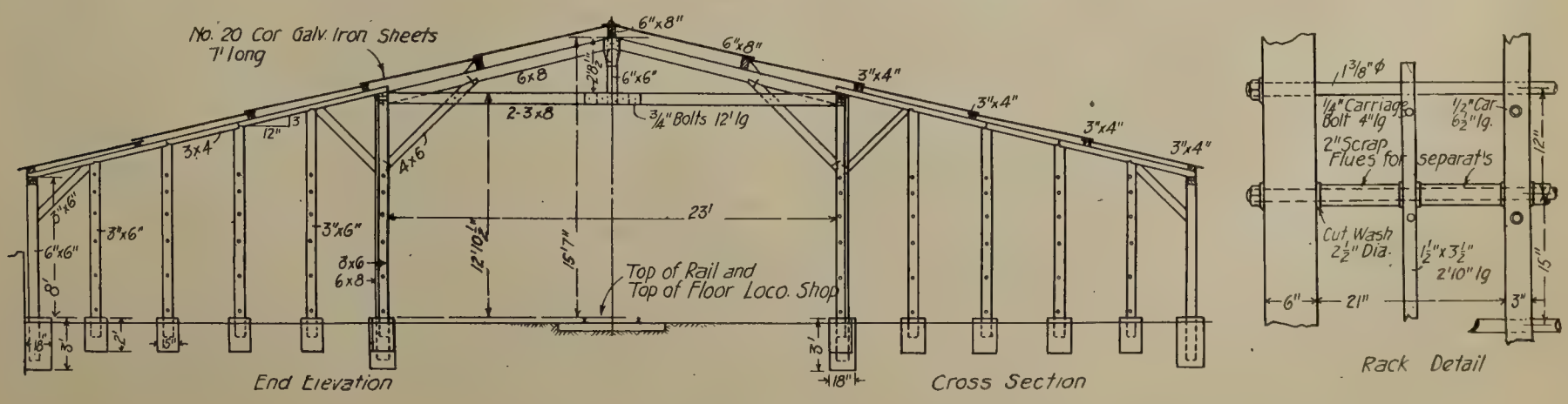
There are two lavatories, one between the smith shop and storehouse and one west of the storehouse. They are modern and sanitary in every respect. White enameled wash basins to the number of seventy are located in each building and are provided with hot and cold water. Between each row of basins is a row of double-tiered steel lockers. There are 875 of these in the two lavatories, enough for the entire force. The buildings are brick, with composition roofing and concrete floors. Near the storehouse is the iron storage rack, 42'x62', having a clear space 20' wide through the center, with racks on either side. A narrow gauge track passes through the center of this space and makes connection with a track to the smith shop. The racks are formed of 3'x6' timbers spaced about 2 feet apart, and are held together with 1⅜" round rods, made of scrap truss rods. On one of these rods near the top and another near the bottom collars are placed between the timbers to hold them in alignment. These collars are made from 2" scrap flues. The roofing is No. 20 corrugated galvanized iron sheets.

The sheet steel rack is 62'x28', and for the division posts 280 pieces of scrap rails are used. They are 15' long and are set vertically in a concrete base 2'6" thick, being spaced at distances varying from 3' to 16". Bolted to the top of the rails are 4½"x3" T irons, forming a support for the roof. This roof is ⅞" pine boards and is movable.

A word might be said here about the location of the buildings previously erected at Decatur. The woodworking plant, which was built about six years ago, is located east of the new buildings, just across a street which cuts through the property. While these buildings are of wooden construction, they are up-to-date and well equipped to handle all work. A noticeable feature is that machines are well provided with safety guards, which in each instance are painted red, thus keeping their purpose in the vision of the men. The roundhouse and terminal is some distance west of the new buildings, about half way to the depot. The roundhouse also is but a few years old.

Power and Piping.

Current for power and lighting is purchased from the Decatur Railway & Light Company, a subsidiary of the McKinley System, a very low rate having been secured by a long term contract. There are 121 motors in both the locomotive and smith shops, ranging from 3 to 208 H. P., the latter being used on the air compressors. Twenty, 15 and 7½ H. P. motors are used on line shafts,



Iron Storage Rack.

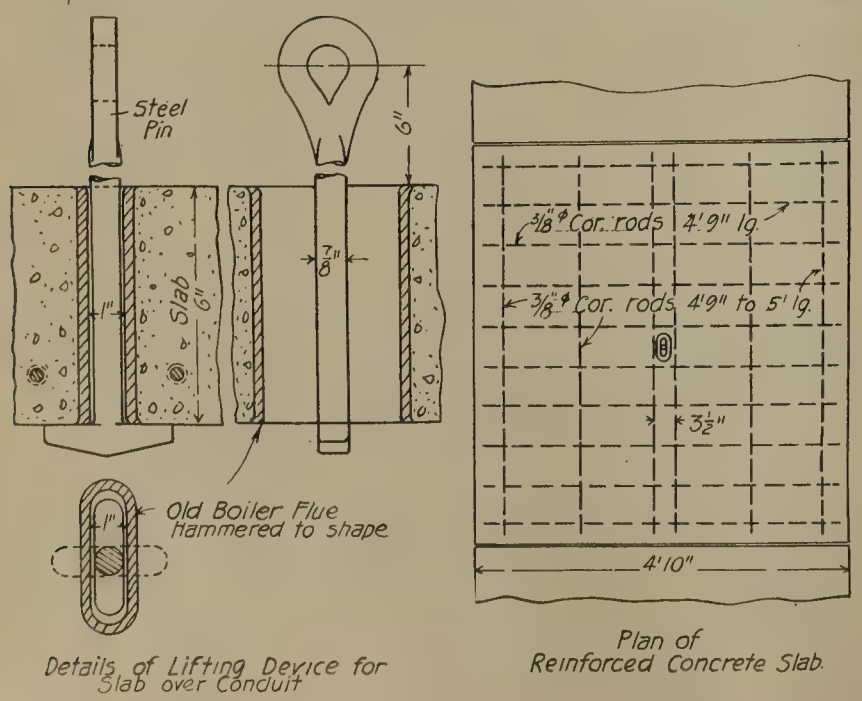
Interior of Lavatory Before Installation of Steel Lockers.

switches and fuses being placed in metal boxes on the columns. Three 300 K-W transformers are located outside the buildings.

As before stated, the air compressors, of which there are three, are located at about the center of the south bay, being enclosed within a railing. These two-stage compressors are of the Ingersoll-Rand make, with 12¼"x16" and 20¼"x16" cylinders, and will each deliver 1,000 cubic feet a minute. A pressure of 100 pounds is carried on the line. They are driven by General Electric synchronous motors running at 225 R. P. M., taking a 60 cycle, 440 volt current of 225 amperes. The warm jacket water from the compressors discharges directly into an open trough in the concrete floor next to the wall, from whence it is pumped into the lavatories and into the smith shop for wetting down.

Two 250 H. P. boilers for supplying steam for heating and other purposes are located in the northwest corner of the smith shop. These are O'Brien water tube boilers. The vacuum system of heating is used, the pit for pumps, etc., being alongside the boiler and covered by a removable concrete slab. Concrete coal bins are built outside, with an opening through the wall in the usual manner.

A concrete conduit, 3'6"x4'0" extends from the boilers to the air compressors in the locomotive shop, carrying the water, steam and air lines. This conduit extends straight across the shop from the compressors, and then follows the outside wall to a point opposite the smith shop, where it makes a right angle turn towards that building. Thus it forms a walk for part of the way. The cover of this conduit is formed by 6" slabs which are so constructed that they can be readily lifted off. The slabs are reinforced and at the center of each is inserted a piece of old boiler flue which has been hammered into the shape of an elongated oval. A ⅞" steel pin with a T end can be slipped into this opening, turned through 90 degrees, and the cover slab then lifted off by a crane. The conduit has a clay pipe drain to the sewer.



Details of Cover of Conduit for Service Pipes.

Air, water and electric connections are placed on every other post in the locomotive shop, connections at one side being staggered with respect to the other. All air lines have a manifold at the bottom, a 1¼" line being dropped down the post and the manifold providing four ¾" outlets. Provision is also made for bleeding by a drain cock at the bottom of the manifold. A number of portable lathes are in use, which can be picked up and dropped where needed, the motor being connected up at the nearest post.

A small trough in the floor alongside the outer wall carries the return pipes for the heating system. All air, water and electric conduits for machines were laid in the grouting, and so carefully has the location of these conduits with respect to each machine been laid out that connections coming up through the floor are apt to escape the eye.

Lighting of the main bay is by means of 75 carbon flaming arcs of 220 C. P., spaced about 52 feet apart and located above the craneway. The white steel work and roof greatly improve their efficiency. Under the balcony and in the side bays 100-watt tungsten lights with reflectors are placed. Individual lights with shades are supplied to machine tools where necessary.

The sewage system is connected to the city system. Water and fire protection are also furnished by the city system.

The shops were put in operation October 20th, and at present two to three hundred men are employed. When in full operation they will employ 850 men, although about 1,000 can be worked in them. W. F. Canavan as superintendent is putting the shop in operation.

H. P. Anderson as mechanical engineer designed and worked out the details under the supervision of E. F. Needham, superintendent of motive power. C. W. Gindle of Chicago was the general contractor.

What disposition will be made of the old Springfield shop is not yet known, although a terminal will be maintained at this point. The offices of the mechanical heads will probably remain there for a time.

Acknowledgment is made to the various officials of the mechanical department of the Wabash for their courtesy and assistance in supplying the data for the preparation of this article.

RAILWAY FIRE PROTECTION ASSOCIATION.

The Railway Fire Protection Association was organized October 7 at a meeting held at the Hotel Sherman, Chicago, Ill. Its purpose is to improve methods of fire protection, to circulate information on the subject and to standardize practices with regard to these matters on railways. The following officers were elected: President, F. H. Elmore, superintendent of insurance, Southern, Washington, D. C.; vice-president, P. Hevener, assistant supervisor of insurance fund, Rock Island Lines, Chicago; secretary-treasurer, C. B. Edwards, fire insurance agent, Mobile & Ohio, Mobile, Ala. The following were elected members of the executive committee: R. H. Newbern, Pennsylvania, Philadelphia; Col. B. W. Dunn, New York; B. S. Mace, Baltimore & Ohio, Baltimore; G. G. Tunell, Atchison, Topeka & Santa Fe, Chicago; N. Searles, Southern Pacific, San Francisco, Cal.; W. S. Langford, New York Central Lines, New York.

About forty were in attendance at the first meeting. Papers were read by Charles N. Rambo, superintendent Mutual Fire, Marine and Inland Insurance Co.; E. B. Berry, chief inspector, Southern Railway.; Col. B. W. Dunn, H. T. Bentley, Anson Murphy, A. D. Brooks, P. Hevener and B. S. Mace. The annual meeting is to be held the first Tuesday in October, at a place to be fixed by the executive committee.

ABATEMENT OF LOCOMOTIVE SMOKE.*

By D. F. Crawford, G. S. M. P., Pennsylvania Lines West.

Considering the many years that this subject has been under discussion, it would seem that very little has been accomplished, but this is not remarkable, nor does it apply to locomotive smoke alone or even smoke from any other source.

It seems to be a human quality to first endure, become accustomed to, be indifferent to, and then regard as a necessity, or at least as a necessary evil, anything for which an immediate remedy is not at hand. This condition delayed for years many of the sanitary precautions taken today, such as the arrangement for pure water supply, sewage disposal, etc.

While it may be truly said that little has as yet been accomplished in the abatement of locomotive smoke, it must be borne in mind that, taking into account the comparative difficulties of the problems presented, quite as little has been accomplished in the abatement of smoke from other sources—particularly the stationary boiler.

Of the smoke produced in any locality where bituminous or soft coal is generally used for manufacturing, power and domestic purposes, I think it will be found that locomotives contribute but from 15 to 20 per cent, with perhaps a somewhat higher proportion in localities where comparatively few industries are located and, of course, a considerably greater proportion where fuel other than bituminous coal is used for domestic purposes.

The emission of smoke in the large quantities inherent to the use of large locomotives has permitted the railways in America to produce transportation of passengers and freight at the lowest cost of any country in the world, as to obtain this result large units and consequently large coal consumption is necessary.

The above presents the problem which confronts the railway officer in considering this subject. To obtain from the modern locomotives the average power required from them it is necessary to consume fuel at the rate of about 100 pounds of coal per square foot of grate per hour, and to obtain the maximum power required it is necessary to consume 150 pounds, and at times in excess of this amount, per square foot of grate per hour. That is, to obtain the power necessary to perform the work demanded, a boiler which from its heating surface would be rated at about 320 horsepower is frequently forced to develop over 1,500 boiler horsepower, and our records show that another boiler, which would on the basis of heating surface be rated at about 400 horsepower, has developed as high as 1,994 boiler horsepower.

The performance stated above requires coal consumption at the rate of from 6,000 to 10,000 pounds of coal per hour, and in the cases cited this was done on a grate of 55 square feet.

From the above it is surely evident that the abatement of the smoke from such combustion is beyond comparison with the simplicity of taking care of the smoke from a stationary boiler with the low rates of combustion obtained in such practice. Economical railway operation forbids the use of smaller units as well as underloading those in service. Therefore, the situation must be met without diminishing the efficiency of the railway as a transportation facility and with as little additional cost to the purchaser of transportation as may be possible.

Of the methods for the abatement of smoke from locomotives that are available, I have knowledge of the following:

1. The use of comparatively smokeless fuels.
2. The use of air jets.
3. The use of mechanical stokers.
4. The instruction of the men operating the locomotives and supervision of their work.
5. Elimination of the steam locomotive.

Anthracite coal, low volatile bituminous coal, coke and oil may be considered comparatively smokeles fuels, although I am somewhat doubtful as to the inclusion of oil in this list, as the few locomotives I have seen using this fuel produced a great deal of smoke.

The geological map shows conclusively that the study of the abatement of smoke must be based on the use of bituminous coals. For economic reasons as well as the proper utilization and conservation of the natural resources, the railroads must produce power with the fuel available in the territory through which they run.

The available anthracite coal is located in eastern Pennsylvania, and even if the cost were not prohibitive the entire output would not be sufficient to supply the demand for locomotives alone.

Low volatile bituminous coal under favorable conditions produces considerably less smoke than that containing a large amount of volatile matter, and has been and will be used to meet special conditions. However, the supply is located at comparatively few points, and its general use would not only add greatly to the cost of transportation, but prevent the ultilization of other fuels until the supply of the low volatile fuel becomes exhausted, when the problem would again come before us.

About fifty million tons of coke is produced per year, practically all of which is used for metallurgical purposes. Of course the output could be increased, but can we afford the necessary loss of one-third of the heat value of the coal used in its production?

Coke is not a satisfactory fuel for locomotives, and its general use would considerably reduce the capacity of the existing locomotives, resulting in economic waste.

The use of oil is, of course, confined to localities where it is sufficiently plentiful to warrant its use, and I am advised that the supply is now so limited that some of the roads on which it is used are compelled to return to the use of coal.

Inasmuch as the kind of coal which will most likely be used is apparently settled by the geological distribution of the coal and the geographical location of the railways in relation thereto, it would seem necessary to devote our energies and time in an endeavor to meet the situation with the materials available.

I will therefore take up the mechanical devices for smoke abatement with which we have had some experience.

It is a well-known fact that to support combustion a certain quantity of air must be supplied for each pound of fuel burned. In an endeavor to provide an adequate air supply many experiments with air or steam jets have been made, resulting in a large number of designs covering the type of jets and suggested location and arangement.

These devices for the mechanical mixture of air and gases were supposed to be equally useful for either stationary or locomotive boilers, and some of the various forms have from time to time been applied to quite a large number of locomotives. Notwithstanding the almost general failure of this type of smoke reducer, the occasional success was sufficient stimulus to make its use attractive to those in charge of the abatement of smoke in various localities, and to the railway officers co-operating with them in their desire to assist in smoke reduction. Therefore it was decided at a conference of railway officers to appoint a committee to make a scientific study of the scheme as well as carefully planned practical experiments. This committee, of which I had the honor of being chairman, was composed of representatives of seven railroads, and all of them had had long experience with the locomotive and with the use of air jets of various forms for the abatement of smoke, as well as a keen interest in the subject before them.

Upon examination of the drawings showing the arrangement, location and dimensions of jets in use on a number of railways, it was found that the variations in practice were so great that without more definite information no conclusion could be reached, and arrangements were made with the Pennsylvania Railroad for a thorough test on the locomotive testing plant installed by the company at Altoona, Pa., of a locomotive provided with jets of several designs, locations and arrangements approved by the committee.

* From a paper read before the International Society for the Prevention of Smoke.

In order that all may appreciate the facilities offered by a locomotive testing plant for tests of this nature, a brief description of the plant and its uses will be of value.

To enable the locomotive to work and develop power, and at the same time remain in a fixed position, there is provided a sufficient number of supporting wheels to take the place of the usual track under each driving wheel of the locomotive. The revolution of the supporting wheels is resisted by adjustable brakes upon them, permitting the resistance to be varied so that the work done by the locomotive may be made to conform to the work expected of it on the road.

The locomotive is firmly connected to a dynamometer which measures the output of the locomotive, and at the same time prevents it moving forward off of the supporting wheels. Apparatus for weighing the fuel and water supplied and for observing and recording all data necessary for any given test is provided.

The locomotive remaining in a fixed position permits of careful observation and tests, which would be entirely impracticable with the same locomotive running under the varying conditions in road service.

That it is admirably adapted to "smoke observations" is evident from the fact that it may be operated continuously for a given time at a given rate with one kind of a device, or one kind of fuel, and, for comparison, be operated with another device or fuel at exactly the same rate and time as in the previous tests.

With fixed conditions the results obtained with different devices or fuel may be accurately judged and rapidly determined.

To make the tests of the air jets a locomotive of the size and capacity largely used in heavy yard or switching service was equipped with all of the necessary apparatus and put on the testing plant, and a large number of tests made. The reports of data obtained is a voluminous document, and through the courtesy of the General Managers' Association, of Chicago, the report was presented at the annual meeting of the American Railway Master Mechanics' Association for 1913. (*A summary of this report was published on page 299 of the July issue of the* RAILWAY MASTER MECHANIC.)

Tests were first made to determine the type, location and arrangement of jets, to give the best results in reducing smoke. This information having been obtained, further tests were made to determine what effect the use of the jets would have on the efficiency of the locomotive in transportation service.

The tests indicate that for locomotives in yard service and switching service for the majority of the time they are in use the introduction of sufficient air to reduce smoke will not seriously decrease their capacity and will tend to improve the economy of coal consumption.

From the results of the test it is clear that there is a field for further study regarding the usefulness of the air jet. One of the difficulties to be overcome in the use of the air jet is the noise produced by the jets when supplying sufficient air to be of value in reducing smoke, and several forms of mufflers, or silencers, are now being used experimentally.

Additional air is necessary to prevent formation of dense smoke at the moment of supplying the coal, and the air jets properly arranged assist materially in reducing the smoke at this time by furnishing the excess air required.

Since the completion of these experiments in March of this year about thirty locomotives on the Pennsylvania Lines, and many more on the other lines used in switching service and yard service, have been equipped with the air jets; the design being modified to meet the conditions of each type of locomotive. These locomotives are under observation to ascertain whether the results obtained in actual service, where the locomotives must of necessity be handled by a large number of men, will be as favorable as those obtained under test conditions.

The design of muffler is also receiving further consideration, as without a satisfactory muffler the noise made by the jets is sufficient to retard, if not preclude, their use.

For the past nine years the Pennsylvania Lines West of Pittsburgh have been working to develop a mechanical stoker for locomotive use, and the results so far have been sufficiently satisfactory to warrant its application to a total of 300 locomotives, of which 215 are at work—66 in passenger, 130 in freight and 19 in switching service.

While, of course, the desire to use the mechanical stoker was primarily brought about by the desire to increase the capacity and efficiency of the locomotive, the question of smoke reduction was given full consideration, as it was felt that less smoke meant less expense for fuel. This device has proved, up to the present time, to be the most promising yet installed for the reduction of smoke from a locomotive using bituminous coal—in fact, under favorable conditions the smoke is practically eliminated.

Repeated comparisons of the smoke produced by locomotives with and without the stoker show that those equipped with the stoker may be operated with from one-tenth to one-third of the smoke made by similar locomotives in the same service without the stoker; the amount of the reduction depending on the class of service and continuity of the run.

Not only is the average amount of smoke made reduced, but the number of times dense smoke is produced is diminished; the large volume of dense smoke apparent each time fuel is supplied to the fire by hand being eliminated when the stoker is used.

Two locomotives, one with and one without the stoker, were attached to a double train of freight cars, so that each locomotive was loaded to its capacity, and observations of the smoke made while pulling the train up a heavy grade. In this case the average smoke was as follows:

Stoker fired locomotive..... 8.0 per cent
Hand fired locomotive..... 78.0 per cent

That the stoker firing is more uniform than hand firing is proved by the fact that the smaller percentage of dense smoke is emitted from locomotives equipped with the stoker.

The results obtained during nine years of experimentation, and the measure of success obtained is due to the interest of the executive officers of the railway in the subject, and their encouragement and authority to incur the expense involved in the work, as well as the interest and hearty co-operation of my assistants and those engaged in supervising the details of construction and operation.

It required much patience to meet the many difficulties encountered in the endeavor to adhere to the principles established (one of which was the reduction of smoke) when the work was commenced.

Since the beginning of experiments to August 1, 1913, locomotives equipped with stokers have made 51,680 trips; of these, the stoker handled 95 per cent or more of the coal used on 34,390 trips, 70 per cent or over on 7,865 trips, and less than 70 per cent on 9,425 trips, less than 70 per cent being considered as unsatisfactory performance.

While the apparatus is now sufficiently developed to warrant the trial of a large number, the problem of maintaining and satisfactorily operating them, with various kinds of coal, and teaching many men how to handle them to the best advantage, is still before us.

It would not be proper to present a paper on this subject without mentioning two other devices, now largely used on locomotives, which assist in reducing smoke—namely, the superheater and the brick arch.

The superheater, which is now applied to many locomotives, and which will be applied to many more in the future, does much toward the abatement of locomotive smoke, in that it permits the operation at a given power output with from 10 to 20 per cent less coal than a locomotive developing the same power not provided with a superheater. Less coal being required, there will consequently be less smoke.

The brick arch, by retaining heat and retarding the flow of the gases, permits their ignition, while without the arch they would escape without reaching the ignition point, and a portion at least would form smoke. The amount of smoke reduction, although comparatively small, is sufficient to warrant consideration, and application of arches alone or in combination with the other devices mentioned.

Of course in this field, as in any other, the degree of success obtained is dependent entirely on how well the work required to accomplish the desired result is done.

Instruction and supervision is necessary to some extent, even when the mechanical devices named above are used.

The cost of fuel represents from 8 to 10 per cent of the total operating cost of the railway, and therefore one of the most obvious ways of reducing operating expenses is to economize in the use of fuel.

As the methods which must be followed to obtain the maximum economy in locomotive fuel consumption are the same as those necessary to reduce smoke, the direct financial interest of the railway is the elimination of smoke.

Therefore, in addition to the study and development of mechanical devices the railways, by additional supervisors and instructors, are causing reduction in the amount of smoke emitted by having more careful firing and handling of locomotives by the enginemen.

At many points the subject of smoke abatement is assigned to men whose sole duty is to observe the amount of smoke produced and instruct the engineman as to its prevention.

In some localities where the locomotives of several roads operate over one another's tracks, the inspectors represent the several railways and report to the proper officer the emission of dense smoke from any locomotive, regardless of its ownership. Such an arrangement is particularly desirable at points where the lines of several railways are adjacent, as it permits a comparatively small number of men to observe a large number of locomotives.

In connection with this I am sure you will be interested in hearing the following extract from the instructions of the Pennsylvania Railroad regarding the abatement of smoke:

"Enginemen and firemen must work together so as to save coal and reduce smoke.

"The burning of bituminous coal in a locomotive requires air, which must be admitted through the grates and through the fire door.

"Smoke means waste of coal and must be avoided.

"Large quantities of coal placed in the fire box at one time cool down the fire, cause smoke and waste coal. Small quantities at regular intervals will keep the fire bright, prevent smoke and take less coal to keep up steam pressure.

"Lumps of coal should be broken in pieces not larger than 53". A bright and level fire over the whole grate must be carried wherever possible. When a sloping fire is used, no more coal should be banked at the door than is necessary.

"To prevent smoke and to save coal, the fire door must be placed on or against the latch after firing coal or using the scraper, slash bar, or hook, and when on siding, in yard, at terminals, or before starting.

"Before the throttle is closed, the blower must be used and the door placed on the latch.

"Firemen must stop firing long enough before steam is shut off to prevent smoke and waste of coal."

Perhaps the most difficult problem in the abatement of smoke from locomotives is the reduction of the amount of smoke made at the locomotive terminals, where fresh fires are made, to prepare the locomotives for service.

Frequently at the larger terminals there will be ten or even more locomotives at one time in which the fires are in course of preparation.

We all know it is quite impossible to build a fresh fire in the house grate or stove without smoke, and that quite dense smoke will continue until a considerable portion of fuel it fully ignited.

The same conditions prevail with the locomotive, only greatly aggravated by the larger amount of fuel required to start the fire, and at times by the rapidity with which the work must be done to meet the demands of the service, the patrons of the railways seldom being willing to suffer delay to either themselves or their goods.

Notwithstanding careful instructions, supervision and experiments with different fuels, mixtures of fuels, and appliances, a satisfactory solution has not yet appeared.

Several years ago we endeavored to collect the smoke and gases by means of suction fans and pass them through water sprays to precipitate the heavier contents, but without success. The size, first cost and operation cost prohibiting a plant of sufficient capacity. A modification of this arrangement, in which the smoke and gases are forced through a considerable body of water, is about to be put in operation, and I am sure it will be watched with interest by all concerned in this subject.

At the present time the Pennsylvania has under construction, at the engine-house in Allegheny, apparatus to carry the smoke and gases from the locomotives in which fires are being prepared, through an underground duct and a fan, discharging them into a stack 150 feet high, 7 feet in diameter. It is felt that this arrangement will not only carry the smoke and gases considerably above the buildings immediately adjacent to the engine-house, but, owing to the size of the stack, permit of considerable precipitation of the heavier particles.

The stack will be so located that it will be possible to interpose smoke washing apparatus between it and the fan, should a sufficiently promising method be developed. Mention is made of this only to inform you that all phases of the subject are receiving careful attention of the railway officials, and that the railways are making expenditures of considerable magnitude in their endeavors to abate smoke.

In the present state of the art, of course, the elimination of the steam locomotive means the substitution of electric motive power for all the locomotives now in use, as no other method is now available.

The word "Electrification" seems to be attractive to everyone save those charged with the responsibility of obtaining the money required to meet the enormous outlay of capital required to install the apparatus and then to continue the operation at rates for carrying passengers and freight which will be deemed reasonable by the patrons, as it has not been demonstrated that electrification will generally result in reduced operating costs.

From the best data available the complete electrification of the railways would eliminate some 20 per cent of the smoke annoyance, and I have often wondered why its application, to ameliorate the discomforts caused by the remaining 80 per cent, was not more strongly urged.

Undoubtedly electric power may be substituted for steam power for many purposes for much less capital outlay, with more promise of a satisfactory return on the investment and with less probability of unsatisfactory service to patrons, than is the case with its use by the railways.

From the information offered by many writers on the subject, one would be led to believe that a steam locomotive is a most wasteful machine and that tremendous savings would result from abandoning their use.

As a matter of fact, the performance of the locomotive boiler compares favorably with the average results obtained in stationary practice, and the performance of the complete locomotive, of modern construction, is sufficiently efficient to permit of obtaining a coal rate of 2.1 pounds per indicated horsepower hour, or 2.5 pounds of coal per horsepower hour delivered at the drawbar of the tender.

Surely such results do not warrant the almost general belief that the locomotive is an inefficient machine for the purpose for which it is intended.

Without doubt the use of electric motive power in lieu of the steam locomotive will be extended, but its use will, at least until there is great improvement in the efficiency, reliability

and reduction of the cost of electrical apparatus and its operation, be confined to meeting special conditions, such as the operation of the lines through tunnels, similar to those under the rivers at New York and Detroit, those in long tunnels through mountains, and certain lines with exceedingly heavy grades and a large volume of traffic, as well as some terminal passenger stations where the location and traffic conditions are such as to readily permit of its adoption.

The cost of everything electric is enormous. The cost of the electric locomotive is at least double that of the steam locomotive, which they are supposed to replace, and before electric locomotives can be operated it is necessary to incur a large additional outlay for power houses, transmission systems, track preparation and all of the other apparatus and material which is necessary to complete an electric system.

One estimate which has been brought to my attention provides an investment of about $200,000 for each steam locomotive displaced, or about ten times the cost of each of the latter.

As there are about 70,000 locomotives in the United States, representing an investment of about one billion four hundred million dollars, I am sure you will agree with me that some exceptionally favorable return must be apparent before they will all be discarded; especially so when their replacement involves an expenditure of many times their present value.

It is true that the demand is rarely made that an entire cross-country line be operated by electric power, but that such operations be confined to the larger cities.

Such an installation, however, except under particularly favorable conditions, involves not only a proportionately heavier investment for the electric plant, but requires the establishment of two locomotive terminals, one each side of the city, and an additional stop at each of the termini for an exchange of the steam for an electric locomotive or vice versa.

Even if the railways could stand the burden of the cost, it is doubtful if the traveling public would tolerate frequent delays of this kind.

While, of course, with an unlimited expenditure of money much might be accomplished by electrification of the railways, to reduce the proportion of smoke now produced by them, it would seem wise to first provide for the transportation and terminal facilities required to meet the growing needs of our country's commerce, and the elimination of grade crossings, etc., before devoting any considerable sum to eliminating a comparatively small amount of the smoke in a particular community.

CAR FOREMEN'S ANNUAL MEETING.

The Car Foremen's Association of Chicago held its annual meeting and entertainment at the Karpen building on the evening of October 13, 1913. The program stated "This is the only meeting of the year provided for the ladies. Any member who comes without his wife (or somebody else's) will be put in stripes or the dungeon. Take your choice." As a result, over half those present were ladies, and the attendance during the evening was between four and five hundred.

The business session was held in the assembly room on the twelfth floor from 8 to 8:30. A large number of applications for membership were received, among which was that of H. E. Passmore, master mechanic of the Toledo & Ohio Central, who announced to the meeting that he was retiring from railway service to become affiliated with the Grip Nut Co. The resignation of J. W. Senger as vice-president was accepted, Mr. Senger having removed to Collinwood, O. The Following officers were elected for the coming year: President, George F. Laughlin, general superintendent, Armour Car Lines; First Vice-President, C. J. Wymer, general car foreman, Belt Ry. of Chicago; Second Vice-President, A. La Mar, master mechanic, Pennsylvania Lines West; Treasurer, M. F. Covert, assistant master car builder, Swift's Refrigerator Line; Secretary, Aaron Kline, 841 No. 50th Court, Chicago.

After the meeting the entire assemblage was entertained in the club rooms on the eleventh floor with an excellent vaudeville and musical program which included such stars as Jack Ponic, the "union" man of the Rhode Island Union Co., and A. F. Young of the International Harvester Co. At the conclusion of the program the floor was cleared for dancing and a buffet luncheon was served in the club lunch room from 10 to 12. W. E. Sharp of the Grip Nut Co., as chairman of the social committee and officer of the day, "in a few well chosen words" called upon retiring President Schultz to say a few words. Then in order to even things up Mr. Schultz lined the newly elected officers up on the stage and made each one speak his piece. Adam La Mar was the last one, but he said that he didn't dare say anything because his wife was not there.

The other members of the social committee were J. R. Cardwell, A. R. McAlpine, J. H. Kuhns, S. T. Rowley, J. R. Mitchell, W. J. Schlacks, W. G. Wallace, Harold N. Scott and C. O. Taylor. The committee, including its chairman, deserves a great deal of credit for the splendid program provided. The Karpen building management with its excellent facilities for taking care of railway gatherings also deserves credit.

ARBITRATION COMMITTEE MEETING

A meeting of chief joint car inspectors, the arbitration committee of the Master Car Builders' Association and representatives of the American Railway Association was held at the Karpen building, 910 So. Michigan avenue, Chicago, on October 28, to discuss recent changes in the rules and to clear up any misunderstandings. The American Railway Association was represented by Messrs. Warner, Moritz and Hedges. Among the interchange bureaus represented were Buffalo, Cairo, Chicago, Cincinnati, Cleveland, Columbus, Denver, Detroit, Ft. Worth, Peoria and Toledo. The rules which received the most discussion were numbers 2, 4 and 95. The arbitration committee after a complete discussion held a meeting on the following day to prepare decisions which were incorporated in a circular.

GOT THE SAFETY HABIT.

One day a very nervous, timid-looking woman, accompanied by a robust farmer, appeared on the platform of a little railway station at a remote country town. For a time she devoted her attention to the time table, but she did not find there the information she sought, and she stepped up to the station master as he came out of the office.

"Will you please tell me if the three-fifteen train has gone yet?" she asked, in apparent concern.

"Yes, about 20 minutes ago," he replied.

"And when will the four-thirty be along, do you think?"

"Why, not for some time yet, of course."

"Are there any expresses before then?"

"Not one."

"Any freight trains?"

"No."

"Nothing at all?"

"Nothing whatever."

"Are you quite sure?"

"Certainly I am, or I wouldn't have said so."

"Then," said the timid woman, turning to her husband, "I think we'll cross the tracks, William."—*Youth's Companion.*

A DINNER WAS TENDERED on October 18 to J. M. Shea, general foreman of the Cincinnati, Hamilton & Dayton and the Baltimore & Ohio Southwestern at Cincinnati, Mr. Shea having resigned his position to retire to his farm at Cameron, W. Va. The dinner was held at the Sterling Hotel, Cincinnati, and was attended by about fifty car foremen and their wives. Mr. Shea and others were called upon for a few words and it is the hope of Mr. Shea's friends that the railway service has not lost him for good.

Training of the Railway Employee*

By A. Kipp, Mechanical Superintendent, Minneapolis, St. Paul & S. Ste. Marie Ry.

The railway official has, as one of his problems, the training of men to fill positions of responsibility. He has to develop the capacity of men, coming from the ranks, so that they are broadened to carry the responsibilities that go hand in hand with the administration of the affairs of which they are to have control. In addition to this, he must meet a condition which is growing rapidly, necessitating a broader training for the men of the rank and file. The corporation and its employees have, as a result of the progress of organization, grown apart, and plans through which a better understanding and a more sympathetic feeling can be introduced, seem desirable and necessary.

In the case of the individual there seems to be a demand for a training better and more thorough than that which is the usual course followed by the men coming from the ranks. It frequently happens that a man is selected and put into a position without having had any previous knowledge of such an action on the part of his superiors and with no coaching. He frequently fills the position in which he is placed, broadening the best he can with his own efforts, as he goes along, carrying the responsibilities of his position with all the work attached to it, and with no particular well defined scheme in which he can prepare himself for a higher efficiency and greater responsibilities.

Only recently have we read in one of the railway papers the question: "Why do not young men with a college training remain in the railway service?" This question has often been discussed, and while the railways have retained a large number of college men, it is true that a good many capable men who have obtained a college training have entered the railway service, only to give it up after they have surveyed the field of their future employment. They have realized the odds against which they have to work, and the future in store for them, which is their probable compensation for the years of toil they would have to serve to reach the end. These men have found other lines giving them greater opportunities for development and higher rewards for ability and energy. The man who has not had the opportunity of the college graduate, but has the same ambition to do things and develop to his maximum capacity, when coming from the ranks, has had to accept the handicap, where the college man has been able to get away from it.

The opportunity of developing capacity through habit of thought should be given the man long before he leaves the ranks. Judgment develops with practice, it is true, but it is surer when the habit of thought has been directed along the right lines. It is, therefore, a safe plan to pick out the man in the ranks, guiding him, possibly long before he is needed, for a position of higher responsibility. He should be given an opportunity to adjust his view point while he is still in the ranks. When he finally reaches the first step beyond the ranks and becomes a foreman, a trainmaster, or has a position of a similar nature, there is a possibility of developing his capacity beyond what it will be by confining him strictly to his responsibilities and duties, if he is taken into the confidence of his superiors, by being given an insight into the work beyond his daily tasks, or in other words, if he is schooled to give him an insight into larger problems that will broaden his usefulness and prepare him for the future.

The board field of work of the railway clubs has its direct bearing on this training. Because of the education which it is possible for the members to obtain when taking an active part in them, they should be encouraged. Possibly the attendance at the meetings of this club would be greatly increased to the mutual good of its members and the organizations they serve if the men were to receive greater encouragement in their attendance upon these meetings.

To the men in the ranks is due the education, with the purpose back of it, of training them to see the relations which may and should exist between them and their employers, resulting in greater sympathy and creating an esprit de corps so much to be desired in any organization. We have, on innumerable occasions, been made to feel the influence that has been and is being brought to bear on the men in the ranks, teaching only one side of their existence and of the relations of the employer to the employee. We need a stronger counter-influence generally, and this can only be accomplished by means of education. It is the duty of the employer, or in other words, the officers who are responsible for the administration of affairs, to provide a means by which such training can be given. We do not believe that there has been a sufficient progress made along these lines.

The study of efficiency has many students and considerable thought is being given to the best result from an individual effort, or the greatest product from a dollar's expenditure. Efficiency engineers are reorganizing shop methods and systems of accounting. They are putting men on piece rates and are suggesting methods of educating them to produce the greatest amount with the fewest movements. This is efficiency. These activities are directly in line of progress and will have their successful end, but there are other means of education that are worthy of consideration.

The young men in our mechanical trades are learning them through apprenticeships, in which they are given a prescribed course under instructions, or they are learning by means of promotions from one class of work to another, until they have obtained a knowledge of the trade. This, in a large number of our shops, extends only over the practical training in the operations to be performed. On some systems they are going further in giving a training in mathematics and drawing.

Locomotive engineers and conductors are trained for their positions through an apprenticeship course as fireman or brakeman. While serving in this capacity they must necessarily receive a large part of their instruction from the engineer or the conductor, supplemented by that given by their superiors. The amount of instruction coming from the officer varies considerably, depending upon the territory and number of men he has to control. The training is further supplemented by the air brake instructor and in some cases the fuel instructor. Instruction cars, in charge of these latter men, are in extensive use. The enginemen are stimulated to study the principles of the mechanisms of locomotives, the principle of combustion, etc., to meet examinations. Such systems have their usefulness and are quite necessary. We believe, however, that a greater degree of training is advisable. We believe there is good ground for rapid extensions of the systems found in some of the organizations where shopmen are given courses in mathematics and mechanical drawing. In such courses there is an opportunity to develop the minds of the younger men and start their thought habits in the right direction. The idea of a better education for the boys of those classes is gaining ground. This has invaded the precincts of the State legislature. In Wisconsin there is an apprenticeship law, made effective in June, 1911, which is the companion-piece to a law authorizing the extension of industrial education. The object of this statute is the establishing of the well-known indenture system, in which the young man contracts with the employer under an agreement, a part of which is that he shall receive a training outside of the shop training, including instruction in English, business practice, physiology, hygiene and the use of safety devices. The law is modeled closely after those existent in Germany, which, it is claimed, have worked admirably. It may not be advisable to extend such an education to men in the road service or in other departments, but a clearer understanding of the problems in political economy and sociology could be given these men through lectures

* A paper read before the Western Railway Club.

and literature. Some railways have already adopted the magagine, through whose pages all of the employees can be reached in a most effective way.

It is the plan of some railways to stimulate the employee to the feeling that he is a part of the organization and to encourage the feeling of security in a life position, for which he is eligible as long as he performs his work efficiently. This is done through the pension system. This, in short, is a method of retiring employees who have become too old to perform efficient service, or for whom the work has become too strenuous, and of compensating them on a basis of their previous income and their length of service. The usual practice, I believe, has been to pay an equivalent of 1 per cent for every year's continuous service of the average income of the last ten years of that service. The usual age limit is 70 years, beyond which there is no discretion given for continuing service. A good practice, however, followed in some cases, is in making the minimum limit 65 years, with discretion given the employee and the employer for continued service up to the 70th birthday.

Another feature, which has probably not been extended as far as the pension system, but worthy of consideration, is that of forming an association among the employees to serve as a savings association. A detail of such a system may be best explained by covering the outline of such an organization formed by the employees of the Soo Line, which organization has been made possible by the hearty support of the officials of that company. This is known as the Soo Line Co-Operative Association. The object as stated in the articles of incorporation and by-laws is:

"To fraternize the employees of the Minneapolis, St. Paul & Sault Ste. Marie Railway Company and its subsidiary companies.

"To encourage its members to systematically save some portion of their income, the purpose being to combine the small savings of the many employees and to make it possible for the saver of small amounts to have a profitable investment for his or her savings.

"To invest the combined savings of its members in securities of the company.

"To bring about the general co-operation of members towards the best and most economical service for their company, so that the association's investment will make the best possible returns to its members.

"To be the means of bringing employees into closer touch and harmony, acquainting each and every one with the fact that each one, no matter what the position occupied, is or should be working to give the public the best possible service, making the railway a greater benefit to all the communities it serves."

All members of the association are put on an equal footing, each member having one vote, regardless of his subscription. Each month there is deposited with the treasurer of the association a given amount previously subscribed. The funds thus accruing are invested in Soo Line securities. An association of this kind puts into the hands of the employee of the lowest degree the opportunity not only to save, but to invest immediately a small saving, though it may be but $1.00 a month. It gives an added interest in the organization for which he is working. The advantages to the employee can readily be seen and the power of such an organization for mutual benefit can well be understood.

In a recent conservation with a locomotive engineer, who had been in the service of his company since 1882, we were told that he had been purchasing some of the railroad company's bonds and that he had decided that that was about as good a thing as he could do with his money, and he added: "And I want to tell you that it makes a fellow feel a whole lot different. He has an added interest, feeling that he owns some of those spikes and ties that he is running over." He told of one of his associates, a man who had been afraid to invest his money, but who kept a great deal of it in safety deposit vaults. This man had been persuaded to purchase some of the same bonds. His attitude and the feeling he had toward the company was thus changed very considerably. Both of these men had been the kind we considered loyal, men of the old school.

Associations of this nature, investing either in the securities of the company, or even advancing the welfare of the men along the line of building associations, encouraging them to build homes in their town or cities, are bound to build up a spirit among the employees which can be considered a valuable asset.

In addition to this, there are welfare systems which are now being given serious consideration, such as the organization of "Safety First" committees, and instruction along the lines of personal safety. A great deal has been written of this commendable movement and it needs no explanation other than the comment that it has its place in the organization.

Associations similar to the Railroad Y. M. C. A., established at terminals and near repair shops, giving men club-houses where they can get accommodations and can meet associates under environment of a higher level than those they will find in saloons, are most commendable.

Rule "G" in the American Code is one which must be enforced more than it has ever been before, but the logical way to enforce the rule is through the exertion of an influence, if not the real expenditure of capital, toward the introduction of community or club-houses, which will lend the environment so necessary to combat the bad influence into which men, particularly those without families, often drift.

The world has had many natural leaders, men who by sheer force of character have been able to carry with them the masses with whom they come in contact. Such men are not numerous. They are not developed for the needs of every organization, and without such men an organization must have some power to accomplish the same result. It is safer to build up an organization, the official roster of which is composed of men loyal to the organization and not to a man, and with rank and file trained to an appreciation of their relation to the organization. Such an organization will outlive that based upon the one-man power.

SCHOOL FRIENDS.

The conductor of a western freight train saw a tramp stealing a ride on one of the forward cars. He told a brakeman in the caboose to go up and put the man off at the first stop. When the brakeman approached the tramp the latter waved a big revolver and told him to get away.

"Did you get rid of him?" the conductor asked when the train was under motion again.

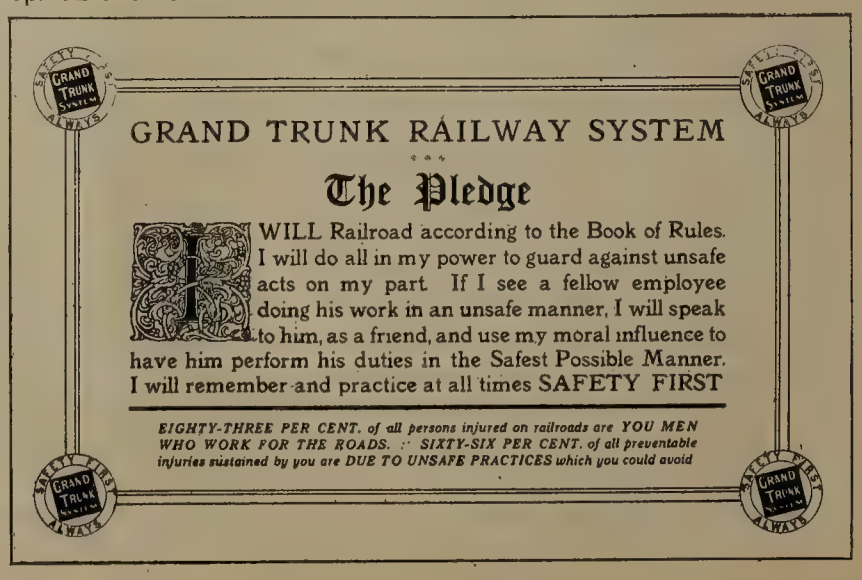
"I hadn't the heart," was the reply. "He turned out to be an old school friend of mine."

"I'll take care of him," said the conductor, as he started over the tops of the cars.

When the train had again started the brakeman came and said:

"Well, is he off?"

"No; he turned out to be an old school friend of mine, too," replied the conductor.


GRAND TRUNK RAILWAY SYSTEM
The Pledge
I WILL Railroad according to the Book of Rules. I will do all in my power to guard against unsafe acts on my part. If I see a fellow employee doing his work in an unsafe manner, I will speak to him, as a friend, and use my moral influence to have him perform his duties in the Safest Possible Manner. I will remember and practice at all times SAFETY FIRST
EIGHTY-THREE PER CENT. of all persons injured on railroads are YOU MEN WHO WORK FOR THE ROADS. SIXTY-SIX PER CENT. of all preventable injuries sustained by you are DUE TO UNSAFE PRACTICES which you could avoid

DEFECTIVE TIRES.

A passenger train of the Big Four was derailed near Stockwell, Ind., on January 7, 1913, resulting in the death of one passenger and the injury of sixty-six passengers and four employees. The train was known as the Chicago Express and consisted of a postal car, baggage car, smoking car, coach, cafe car and two parlor cars and was running about fifty-five miles per hour. The locomotive and mail car remained on the track, the baggage car was derailed on the north side of the track, while the remainder of the coaches were derailed on the

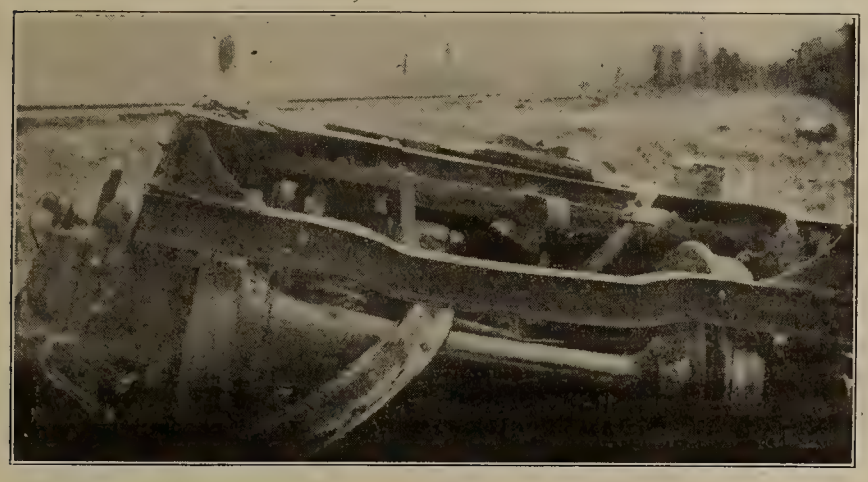


Fig. 1. Forward Truck of Baggage Car, Which Was Located Five Rail Lengths to the Rear of Its Car. Fractured Tire Encircling Axle.

south side of the track. All cars in the train except the second car from the rear end were of wooden construction. The baggage car was practically demolished and an investigation of the accident showed that it was caused by a broken tire on the forward truck of this car, which was the second car from the locomotive.

A report covering this accident has recently been issued by the chief inspector of safety appliances of the Interstate Commerce Commission, and contains also a report of the engineer-physicist of the Bureau of Standards on the broken tire which caused the accident. The report gives the testimony of a number of car inspectors, who had found nothing out of order in an inspection of the wheels by observation. Considerable of this article is extracted from the report:

Superintendent of Motive Power Garstang stated that with the wheels now commonly used, tapping the wheels with a hammer would not indicate anything, and the most approved method of inspecting car wheels was by observation. Mr. Garstang also stated that the wheel on which the tire was broken was known as a single-plate, solid-center wheel; the tire was applied to the wheel center by shrinkage, and there were two retaining rings which clamped the tire, one on each side, being held in position by 10 or 12 rivets.

Fig. 2. Axle and Fractured Tires, Together With Bent Retaining Ring.

Referring to the broken tire, Mr. Howard, the engineer, says: The character of the fracture was such that while it is believed to have been the extension of a thermal crack previously existing in the tire, its development by stresses in the track and complete separation would take place very promptly when the final stage was reached. The shrinkage of the tire upon the wheel center was the chief element of strength or resistance which kept it in place when intact. When fractured this resistance was lost, and only the strength of the rivets of the retaining rings would then be available for holding it in place. Successive side lurches of the car, common to all train movements, overcame the strength of the rivets by flange blows, ultimately forcing the tire off the wheel center.

In discussing the cause of thermal cracks, Mr. Howard points out that the tires are placed on wheel center under shrinkage strains reported to range from 1/80 to 1/60 inches per foot of diameter; but shrinkage strains are variable factors under service conditions; they change as the tire becomes worn, and cold rolling of the metal at the tread has a tendency to modify the strains. He further states that the greatest factor in the case, however, is the application of the brakes. The tread is suddenly heated by the friction of the brake shoe and the tire expanded before the center is affected, no doubt causing wide fluctuations in the magnitude of the shrink-

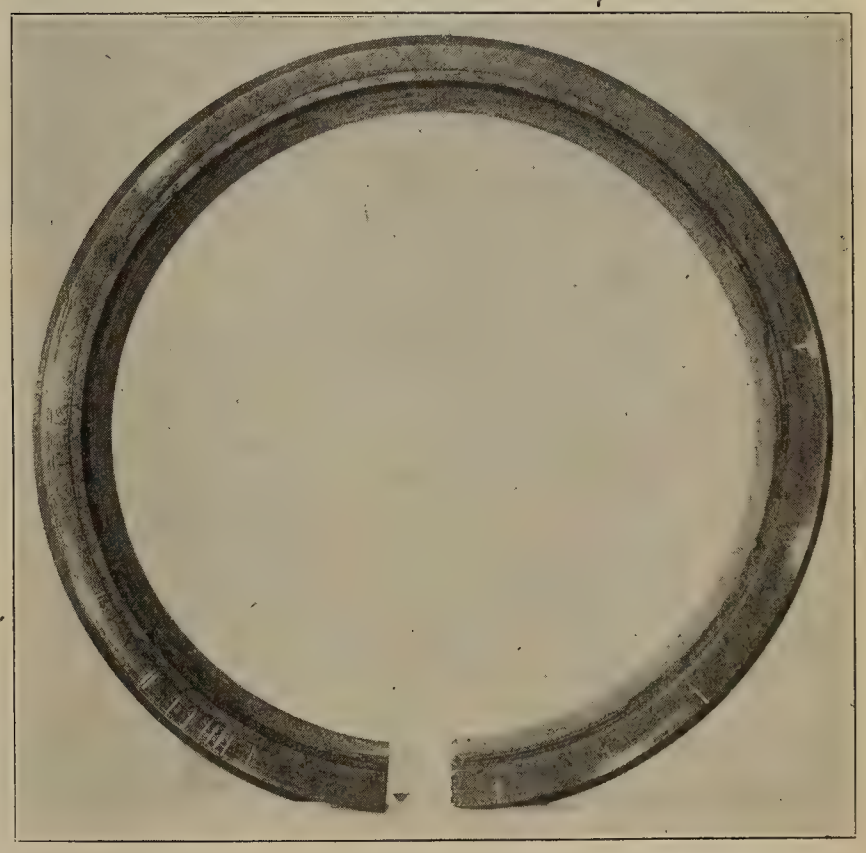


Fig. 3. Fractured Tire. Positions of Thermal Cracks Indicated by Chalk Marks.

strains. Momentarily the tire may be left with very little shrinkage resistance when there is a sudden application of the brakes. The sudden heating of the treads of wheels and the attainment of high temperature assumes a more serious aspect than causing the temporary reduction of shrinkage resistance. Thermal cracks in the steel are formed in this manner, the presence of which is a menace to the integrity of the tire. They are caused by the rapid cooling of the intensely heated metal where free contraction is resisted.

In the tread of the tire which caused this accident there were a number of thermal cracks, as will be noted in the illustration.

The following tabulation, compiled from the commission's accident statistics, shows the number of derailments due to defects of equipment for the five fiscal years 1908 to 1912, inclusive, those due to defective wheels being segregated from those due to other causes:

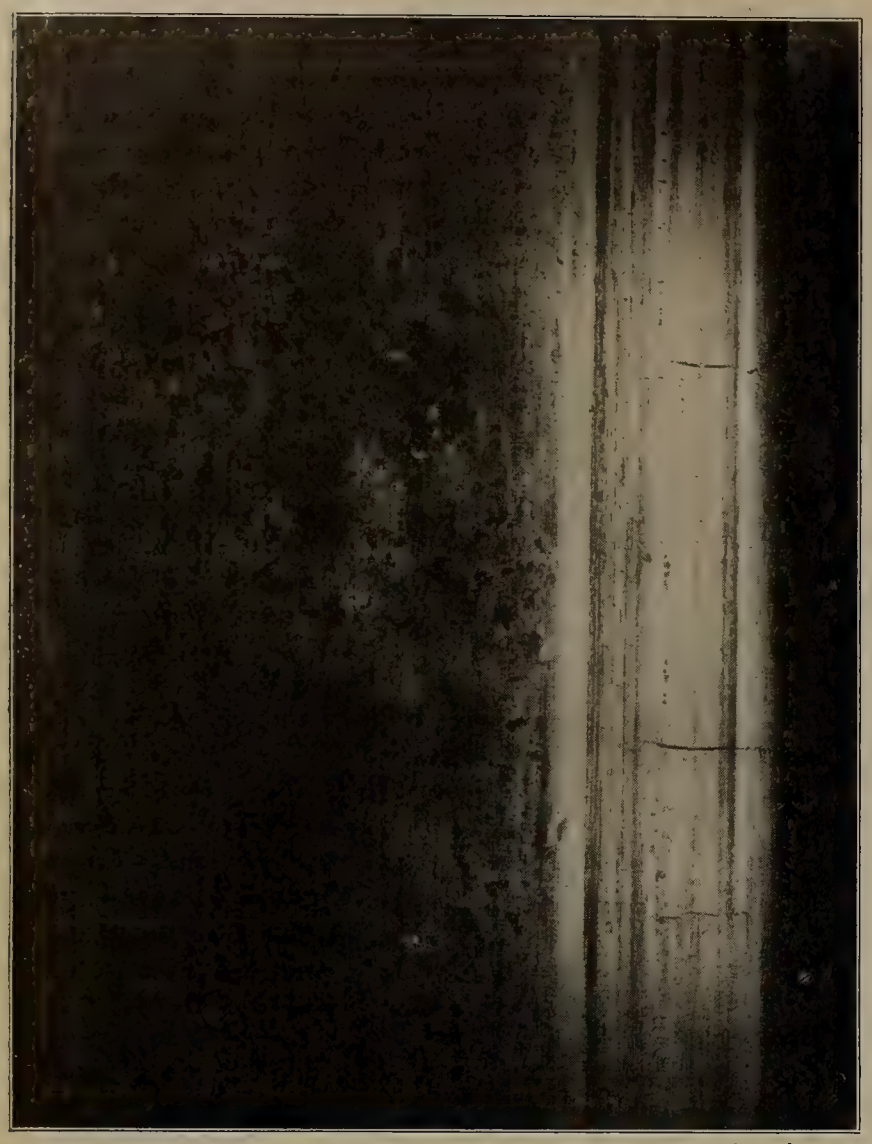


Fig. 4. Thermal Cracks on Face of Fractured Tire.

Year.	Number due to defective wheels.	Number due to other causes.	Total number.
1908	1,031	1,765	2,796
1909	913	1,449	2,362
1910	1,046	1,688	2,734
1911	997	1,827	2,824
1912	1,235	2,612	3,847
Total	5,222	9,341	14,563

The statistics above quoted are sufficient, says the report, to indicate the alarming frequency of accidents due to defective wheels and the seriousness of the problem confronting railroad companies in securing sound wheels and providing an adequate system of inspection, which will insure that defective wheels will not be placed or remain in service, and that worn wheels will be removed from service in ample time to provide for the safe operation of trains.

Referring to the illustrations, Figure 1 shows the detached truck of the baggage car, which was located five rail lengths to the rear of its car. The fractured tire is seen encircling the axle. This view is looking toward Lafayette in the direction the train was traveling. Figure 2 shows the axle with ruptured tire after removal from the truck, and one of the retaining rings, the latter much bent. The lip of the tire, which acted as a lock for the outer retaining ring, was generally broken from the body. The inner lip was not injured. This is one of the results of untiring which would be expected.

The baggage car had four-wheel trucks, 36-inch wheels with steel tires on steel centers and 5 by 9 inch journals. The original thickness of the tire was 3⅛ inches and was 2$\frac{3}{16}$ inches thick at the time of derailment. Total mileage made was 111,113 miles, 60 million rotations in round numbers. The car was in the shop in March, 1912, and the tires were then trued up. The contour lines were satisfactory at the time of derailment and it was not a very much worn tire.

From the design of the wheel the retaining rings can act in two capacities—to hold fragments of a broken tire against outward centrifugal forces, and to restrain the tire against lateral thrust parallel to the axis of the axle. The latter movement or tendency would ordinarily be an inward one, since the wheel flanges are on the inside. Eight $\frac{3}{16}$-inch rivets are provided in the construction of the wheel to hold the tire against such an emergency as arose when this tire fractured. The total sectional area of these eight rivets is a little less than 2 square inches. The two retaining rings, however, have a sectional area of about 60 square inches to resist an outward radial force taken either in tension on the body of the rings or shear of the inner lips.

The tire exhibited on its tread many such thermal cracks, leading to the belief that the complete fracture of the tire

Figure 3 shows the outer end of the tire on which a number of cracks of pronounced size were visible. The location of those which measured one-half inch or more in length, 21 in number, is indicated by chalk marks. A further exhibit of these cracks is made by Figure 4. The outer edge of the tread is shown in this figure, on which appear a number of the longer cracks between which are numerous small ones. The wider and longer cracks were conspicuous, admitting of discovery upon inspection of the tire. Such cracks in steel have grave significance. They lead to early ultimate failure, especially when the causes which occasioned their formation are aided and combined with independent straining forces. The shrinkage strains are always present in the cold tire, and they alone would have a tendency to complete the fracture of the tire

Fig. 5. Thermal Cracks Which Developed in Service in the Tire of Wheel from Baggage Car.

when a thermal crack had reached a certain stage of development.

Thermal cracks are usually progressive in their character, but the rate of their development, a question of deep interest in the case of a tire, does not admit of a definite answer. The depth to which they have penetrated the metal is uncertain. A risk is assumed in running a wheel of this type in which there are thermal cracks. A more satisfactory solution of the problem than judging of the degree of risk involved and reaching a decision as to when to remove from service a wheel of this type in which thermal cracks have appeared would be a modification of the design of the wheel to the end that the element of safety is more amply provided for at a time when the shrinkage resistance between the tire and the wheel center is menaced.

A further examination was made of the tire for the purpose of ascertaining the depth to which some of the thermal cracks had penetrated the metal. It was cut apart in a slotter, for convenience, and fractures made in two places by bending stresses, the surface of the tread being on the tension side of the bend. The cracks opened slightly, then fracture suddenly took place across the full section. Figure 5 shows the progress which the cracks had made, while the tire was still in service, toward its ultimate complete fracture.

Sections measuring 1⅛ inches by ⅞ inch and 1¼ by 1¼ inches, respectively, which appear dark-colored on the figure, mark the extent of these thermal cracks. They had reached nearly half through the thickness of the tire. The gravity of the case is well illustrated in the discolored portions of these surfaces. A series of photographic prints of this kind could properly be placed before car inspectors for their information and guidance.

Methods of inspection may need revision to meet current conditions of railway service, wherein is shown a marked tendency to increase the working stresses, and in so doing decrease the margin in strength remaining between them and the rupturing loads of the materials. Inspection for the discovery of occasional structural defects and inspection for noting approach to the limit of endurance of materials are quite distinct problems, the latter presenting great difficulties. High-wheel loads and the introduction of high-speed brakes are factors in the present case.

The investigation of a specific case of failure, one wheel out of several millions in use, would not in itself possess great interest unless the manner of failure was representative of a general type or class characteristic of other wheels. Failure of the present wheel, however, was reached through conditions which affect others through a common danger to be reckoned with. The cause of the wreck of the train was not material defective in its primitive state, but that which had become so apparently from braking conditions.

SERVICE RECORDS OF VANADIUM STEEL MAIN AND SIDE RODS.

Service records of the Michigan Central show that through the use of vanadium steel for main and side rods, failures of these parts have been reduced 80 per cent.

This represents a comparison between the percentage of failures of vanadium rods on Consolidation and Pacific type engines built since 1910 (since which time rods of this material have been practically standard on this road for these classes of engines) with the percentage of failures of carbon steel rods on the same classes of engines built since 1906, taking into consideration in the latter case only those failures which occurred within a period of three years service or less. The comparison includes 90 locomotives equipped with vanadium steel main and side rods and 84 equipped with carbon steel rods. In other words, it is a comparison of failures of carbon and vanadium steel rods on a practically equal number of locomotives during an equal length of service. Locomotives which have gone into service since the first of the year have been omitted, as, naturally, no failures would be expected during such a short period of service.

The records show that to date there have been only three failures of vanadium steel rods, or only 6-10 of 1 per cent of the total. All of these failures were of side rods. On the other hand, the failures of carbon steel rods prior to 1910 that failed within a period of service of three years amounted to 3⅓ per cent.

Furthermore, it is shown by the records that on one lot of engines built in 1907 equipped with carbon steel rods, the failures of side rods within three years' service amounted to 10 per cent. Of the above engines equipped with vanadium steel rods, two-thirds have been in service since 1910.

The three failures were confined to the first rods applied. These were among the original applications of vanadium steel locomotive rods; and at that time the heat-treating equipment of the locomotive builders might be said to have been temporary and was not comparable to their present facilities. Also when vanadium steel rods were first introduced, the locomotive builders' practice was to simply anneal them. Later the double heat-treatment, which is now followed, was adopted.

One of the above three failures of vanadium rods occurred through the knuckle pin hole and the other two near the end. Of the failures of carbon steel main and side rods, 50 per cent occurred in the body of the rod and the other half either through the crank pin or knuckle pin holes.

The average length of service of the broken carbon steel rods was less than two and one-half years.

Further analysis shows that whereas none of the vanadium steel main rods have failed since 1910 to date, the percentage of failures of carbon steel main rods on Pacific and Consolidation engines during an equal length of service amounted to 2 4-10 per cent, taking into consideration all engines of the above types installed since 1906, and including only those failures which occurred within a three-year period of service.

Lake Shore & Michigan Southern service records, including the Lake Erie & Western and Chicago, Indiana & Southern, show that since 1910, since when vanadium rods have been standard for road engines on these roads also, the failures of vanadium rods have amounted to only 1⅓ per cent. Thorough comparison with failures of carbon steel rods on these roads is imposible as records of rod failures prior to 1910 are not complete. The only basis of comparison is limited to a few road engines built in 1910 equipped with carbon steel rods. On these engines the failures of side rods to date have amounted to 6 per cent. On this basis the comparison shows a reduction of 78 per cent in rod failures in favor of vanadium steel.

On the New York Central & Hudson River records up to last July show that the failures of vanadium steel rods since 1910 have amounted to only 6-10 of 1 per cent.

Summarizing the records on the above five roads, out of a total of 757 road engines equipped with vanadium steel rods, installed since 1910, the total number of rod failures to date have amounted to only ¾ of 1 per cent. Because of the successful results of vanadium steel rods on those roads, which were pioneers in their use, rods of this material have been specified by 20 roads on locomotives ordered this year. At the present time there are over 1,400 locomotives equipped with vanadium steel rods, either in service or under construction, on over 30 railroads.

Locomotive rods are subjected to complicated stresses, which it is difficult, and it might be said practically imposible to accurately calculate. This is probably more true of rods than any other parts of the locomotive, with the possible exception of frames.

A high factor of safety is essential to provide against failures. Considerations not only of maintenance costs, but also of safety, demand the greatest care in design and selection of material to reduce the possibilities of failures to a minimum. Because of their higher physical properties, heat-treated vanadium steel rods offer increased insurance against failure.

BILLING FOR CAR REPAIRS.

By Louis Brentnall.

Since the rendition of M. C. B. bills against foreign railroad companies for repairs made to their cars has become quite a task with most railroads, the matter of systematizing the billing work is of great importance.

Car foremen and clerks at repairing stations usually require special instructions regarding billing against car owners for such repairs as are made by them. This is best accomplished by having a traveling car clerk or traveling bill clerk visit each point and instruct each clerk personally in the keeping of car records and the proper rendering of repair cards. Every little item counts, even a nut or a bolt, as these involve a small material charge for wrought, and also a small labor charge for their application. Where these are not billed by the various repair points, or the car men overlook reporting other minor repairs, the repairing company loses hundreds of dollars.

Compilation of M. C. B. Repair Bills.

The economical handling and billing of repair cards may be accomplished by systematizing the work in a way similar to the following outline:

It is generally best to concentrate the rendering of the regular audit bill in one office, as in the office of Master Car Builder or Master Mechanic, on account of outside points lacking special facilities such as adding machines, etc., and for the reason that the entire billing can be handled in one office with a lesser number of proficient bill clerks.

Under this plan, all repair cards are sent to the main billing office as they are rendered by the many repair stations, or in weekly periods.

The main billing office may handle the incoming repair cards by having a M. C. B. bill clerk whose duty it is to mark on the face of each repair card, in the columns thereon, the number pounds wrought, steel, spring, number feet of lumber and hours labor chargeable for the work done. Repair men should be required to show *sizes* of materials used. Weights of carrier iron bolts, draft timber bolts, draft springs, truck springs, etc., need not be shown on repair cards by repair men, as the regular bill clerk can readily determine these from computing tables, providing the sizes have been shown. Repair cards which are lacking in billing information, as where they do not show the number of the oilbox to which a journal bearing was applied, etc., may be handed to the traveling bill clerk, in order that he may instruct the guilty car clerk when he visits his station.

It is double work, so far as writing is concerned, and a larger bill sheet is necessary, where each item is billed at full price, as ten pounds of wrought iron at 3c, and a credit at corresponding weight is allowed at ½c. The billing is handled much easier and quicker by billing at the net price of 2½c—which allows the credit—inasmuch as the weight chargeable and creditable is the same. In the few cases where it is necessary to show a credit in detail, instead of indicating it, the figures can be shown in the "Item Column," with net charge, in dollars and cents, carried to "Miscellaneous Column" of bill. What's the use of showing credits, when it is well understood what they should be by bill men?

The repair cards which the bill clerk has marked ready for billing may be handed to a woman assistant, who will sort them as to various companies billable, and simply transfer to the bill sheets the data which are shown on each card—car number, initials, number pounds of each kind of material, feet of lumber and hours of labor. Where she uses a carbon sheet under the original bill sheet, a duplicate copy of the original sheet may be had for filing, which obviates the necessity of copying the original sheets in an impression book, which is considerable extra work in handling a large number of bill sheets. Impression copies sometimes become blurred and are difficult to read.

After the billable items have been inserted on the bill sheets and a bill is completed, it can be handed to an adding machine girl, who will add up the totals of the several columns and insert them on each sheet. A girl adding machine operator at, say, $40 a month can add all the outgoing bills, as well as verify the totals of all incoming bills.

Answering Objections to Bills Rendered.

The M. C. B. clerk who never makes a mistake or who has not some peculiarities of billing, may exist, yet every railroad company receives scores of letters calling attention to overcharges. The bill clerk that never makes a mistake is indeed a "rare bird."

Small objections can be answered in handwriting on a printed form, but those which require a reply at length should be dictated. It's expensive to allow a bill clerk worth from $80 to $125 a month to waste time writing, by hand, when a $50 stenographer can do the writing at a saving. This allows the bill man time for posting himself on arbitration decisions, reviewing rules in the M. C. B. code, or studying out ways of handling his work to better advantage. The least correspondence a bill clerk answers with a pen, the greater his efficiency as a special clerk increases.

A Clerk Becomes a M. C. B. Bill Specialist by Training.

There is probably no other railroad clerical position which requires the coaching as that of training a clerk how to render M. C. B. bills. Few clerks have a liking for such work or become interested in it. Many M. C. B. bill clerks become proficient by receiving special instructions from the traveling car clerk, by visiting the repair shop and seeing cars repaired, and by studying the code book. A few of them have had riptrack experience, but the majority of them are clerks with ability, who have been instructed and trained. A clerk must have a liking for the work of billing to make much of a success of it.

Good M. C. B. Bill Clerks Are Scarce.

On account of some railroads looking upon him merely as a clerk, or as one who simply adds and subtracts figures, the M. C. B. bill clerk is somewhat of a nonentity in some offices. Again, there is little encouragement for advancement in such a position, and little hope of an increase in salary without changing positions. A chief clerk may leave and his position filled from the ranks, but when the M. C. B. clerk quits, everything becomes "dead" so far as car repair billing is concerned. Ordinarily, the M. C. B. man is worth all he is paid, whatever that may be, but inasmuch as he is in position to save the company money by billing on a proper basis, the bill man who receives the highest salary is most likely to remain in his present position, while he who believes he is underpaid is likely to seek a change or something different. Considering that he is in position to save the company money in rendering bills, or to find overcharges in checking other companies' bills, he is unlike an ordinary clerk on routine work, and instead of being an expense to the company he is one who is in position to bring the company reimbursements amounting to much more than his salary. There are many more rules in the M. C. B. code today than years ago, and consequently the bill clerk must be a close student, and having served a good apprenticeship he is worth a salary above that of the average clerk, on account of his being a specialist, with the degree "Doctor of Bills." A $100 M. C. B. man can usually see sufficiently farther than a $50 novice to earn the difference between these two amounts in additional savings he perceives when rendering or checking bills.

Questions as to car construction and special billing are continually arising, about which only a practical car man is able to give judgment; consequently, the M. C. B. billing department should be under the jurisdiction of a master mechanic or master car builder, for in reality the only accounting concerned is that of knowing car construction and billable items in order to make, or check, repair charges, after which objections are taken to overcharges or the bill passed to voucher.

Mountain Type Locomotives, Missouri Pacific Ry.

Seven mountain type, passenger locomotives have recently been delivered to the Missouri Pacific Railway by the American Locomotive Company.

These locomotives were designed to eliminate the double heading of the regular passenger trains on the Missouri division, between St. Louis and Popular Bluff, a distance of 165 miles. Leaving St. Louis, the first 42 miles is composed of practically a continuous ascending grade, having a ruling grade of 0.4 per cent. The next 85 miles includes the crossing of the Ozark Mountains which is composed of the ascending and descending of five summits. This is the crucial part of the entire division and is made up of the following very heavy grades: the first summit has a grade of 1.05 per cent., 4 miles long; the second summit, 1.03 per cent., 10 miles long; the third summit, 0.9 per cent., 14 miles long; the fourth summit, 1.9 per cent., 5 miles long, with 5 degree uncompensated curves; the fifth summit, 1.5 per cent., 5 miles long. The remainder of the division is composed of a long descending grade.

Passenger traffic on this division is very heavy. Up to the present time a Pacific type locomotive, having a total weight of 259,000 pounds, weight on driving wheels of 165,500 pounds, and a maximum tractive power of 36,800 pounds, has been used in this service. Two of these Pacific type locomotives were necessary to handle a train of nine cars or more.

The mountain type locomotives have enabled the railway company to handle trains of 12 to 14 cars, or a tonnage up to 820 over the 1.9 per cent. grade at a speed of 18 miles per hour, one locomotive performing this service, whereas formerly it required two of the Pacific type.

This is another striking example of the savings obtainable by designing locomotives exactly fitted for their work, and confining them to their particular territory, with a view of getting the maximum efficiency from every portion of the property.

Compared with the Pacific type, the mountain type has a total weight, engine and tender, of 457,500 pounds as against 420,500 pounds. The mountain type has a tractive effort of 50,400 pounds as against 36,800 pounds for the Pacific. With only 8.8 per cent. increase in weight an increase of 37.0 per cent. in maximum tractive power is obtained.

A weight limit of 210,000 pounds on drivers was specified. This necessitated a very carefully designed boiler. In the following table a comparison is made of the boilers of the mountain and Pacific types.

	Pacific type.	Mountain type.
Pressure	180 lb.	170 lb.
Boiler type	Ex. Wag.	Conical Connection
Boiler, I. D., first ring	72⅜"	74¼"
Boiler, O. D., largest course	83⅜"	87½"
Firebox length	108⅛"	108⅛"
Firebox width	66"	75¼"
Tubes, number and diameter	223—2"	218—2"
Flues, number and diameter	32—5⅜"	32—5⅜"
Tube length	20'—0"	20'—0"
Combustion chamber length		37½"
Heating surface, tubes and flues, sq. ft.	3221	3165
Heating, surface, firebox, sq. ft.	209	260
Heating surface, arch tubes, sq. ft.	26	26
Heating surface, total, sq. ft.	3456	3451
Superheating surface, sq. ft.	757	761
Grate area, sq. ft.	49.5	56.5

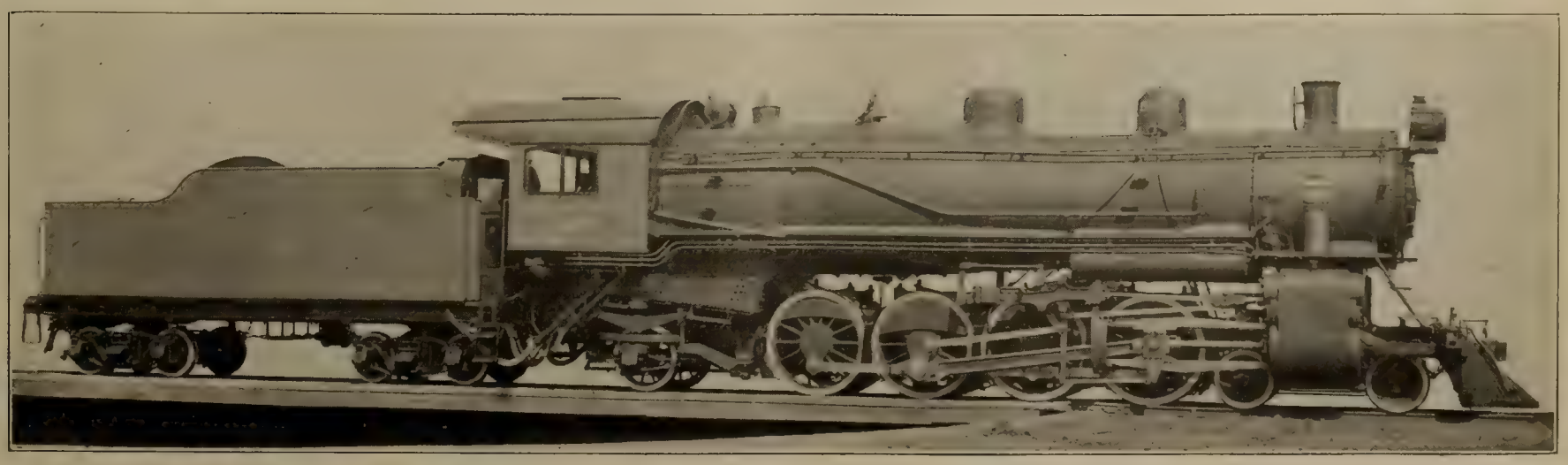
It will be noted that while there is practically no difference in the total heating surface of both boilers, the mountain type boiler contains a combustion chamber. By increasing the front end diameter 1⅞ inches, and the diameter of the largest course 3⅞ inches, the addition of the combustion chamber made a reduction of only 56 square feet in tube heating surface but added 51 square feet to the firebox heating surface.

Firebox heating surface has approximately six times more evaporating value than tube heating surface. Considering the 10 pounds reduction in pressure, the addition in grate area of 7 feet coupled with the greater value of the heating surface, it will be observed that the capacity of the boiler has been greatly increased.

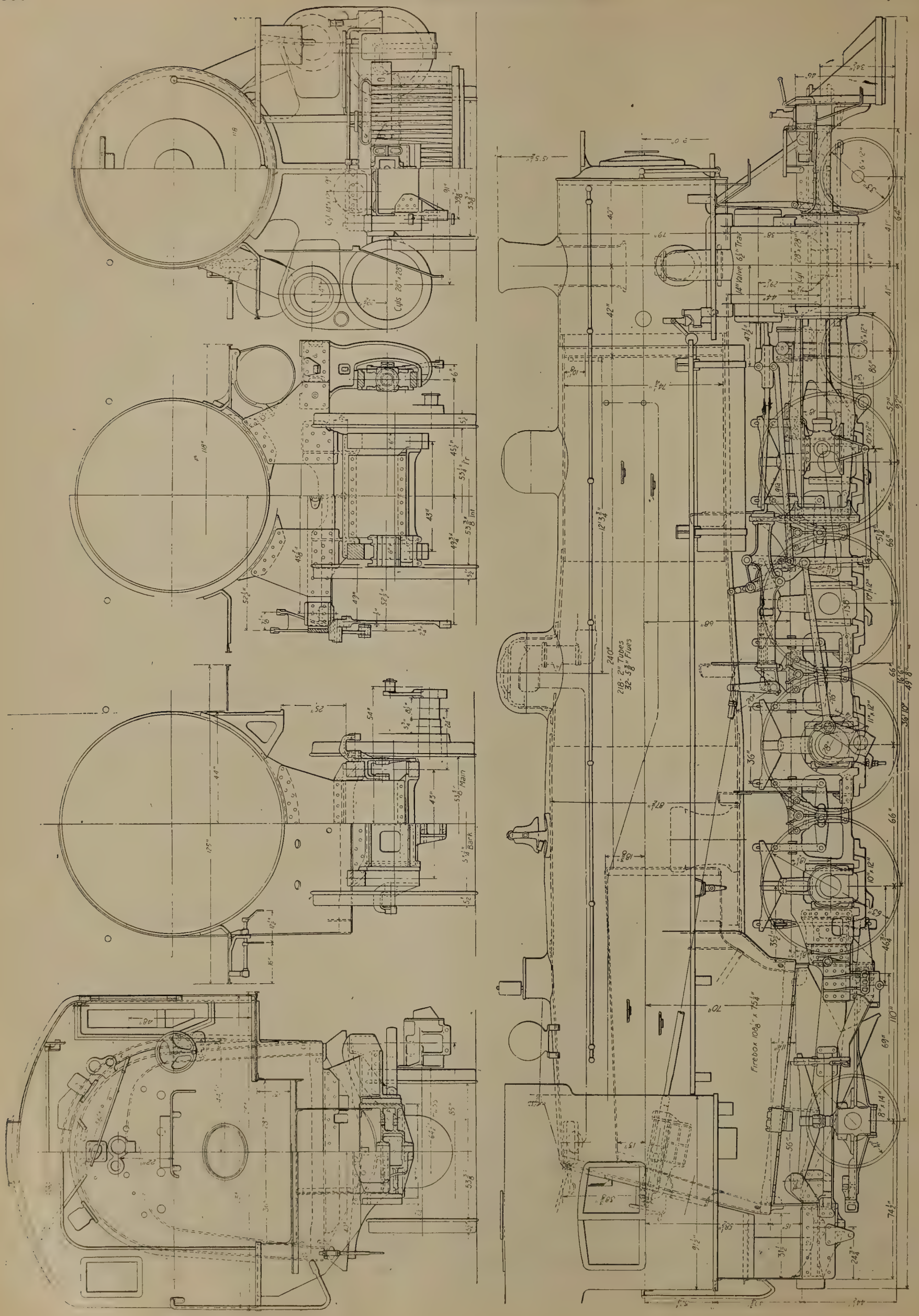
This boiler, being restricted by the weight limit, would not allow the application of cylinders larger than 28x28 inches. To obtain the desired tractive effort, the driving wheel diameter was reduced to 63 inches. As these mountain type locomotives are not intended for the sustained high speeds demanded of the Pacific type, this 63 inch wheel coupled with the above mentioned boiler allows these heavy trains to ascend the steep grades at comparatively high speeds. It is also amply large to attain the necessary speed when descending the grades where boiler capacity does not become a factor.

In every detail, as in general construction, the design embodies the latest approved practice. It is equipped with a superheater, firebrick arch, screw reverse gear, outside steam pipes, extended piston rods, the builder's latest improved outside bearing trailing truck, the latest design of throttle lever, and the Foulder design back end main rod.

This main rod deserves special mention. With this solid end main rod, four of the 1⅜ inch bolts of the strap end main rod have been eliminated, and an actual saving in weight of 115 pounds per rod was obtained. Thus a saving of 115 pounds counterbalance was secured. Also only one pattern is required for the bearings, as the same brass is used front and back of pin, the taper being on the two adjustable wedges. The heavy wedge immediately in front of the bearing extending to the full depth of the rod opening, and being of greater depth than the bearing itself, provides a fine support for the brass and pre-



Mountain Type Locomotive for the Missouri Pacific System.



Elevation and Sections of Mountain Type Locomotive.

vents it from cocking and becoming distorted. Other features of this solid end are its simplicity and the time saved in taking it off the engine; and there are no bolts to renew or holes to re-ream.

These locomotives are not merely big, but were designed with careful consideration of all the conditions of service, which the American Locomotive Company's engineers had first thoroughly studied. They are the product of this company's wide experience in the design and construction of big locomotives, supplemented by the complete knowledge of the officials of the railway company's motive power department.

The principal dimensions are as follows:

Gauge	4'-8½"
Fuel	Bituminous Coal
Weight in working order	296,000 lbs.
Weight on drivers	208,000 lbs.
Weight on trailers	40,000 lbs.
Weight on engine truck	48,000 lbs.
Weight, engine and tender	457,500 lbs.
Wheel base, rigid	16'-6"
Wheel base, engine and tender	70'-0"
Wheels, driv., dia. outside tire	63"
Wheels, engine truck, dia.	33"
Wheels, trailing truck, dia.	42"
Wheels, tender truck, dia.	33"
Axles, driv. journals, main	11"x12"
Axles, eng. truck journals	6"x12"
Axles, trailing truck journals	8"x14"
Axles, tender truck journals	6"x11"
Firebox	108⅛"x75¼"
Firebox water spaces	4½"
Crown staying	Radial
Tubes, No. and dia.	218—2"
Tubes, length	20'-0"
Flues, No. and dia.	32—5⅜"
Heating surface, tubes and flues	3165.2 sq. ft.
Heating surface, firebox	260 sq. ft.
Heating surface, arch tubes	25.5 sq. ft.
Heating surface, total	3450.7 sq. ft.
Superheating surface	761 sq. ft.
Grate area	56.5 sq. ft.
Cylinders	28"x28"
Valves	14" piston
Tank, style	Hopper
Tank, water capacity	8,000 gallons
Tank, fuel capacity	14 tons
Tractive power	50,400 lbs.
Factor of adhesion	4.13

INTERCHANGE OF CARS.*

By H. Boutet, Chief Interchange Inspector, Cincinnati, Ohio.

In the efforts of the railroads to increase their efficiency to meet the ever increasing demands of the transportation business the interchange of cars is one of the matters that is occupying the attention of the transportation and mechanical officials today.

Much improvement over old methods has been brought about; cars are gotten through the terminals with much less delay as it seems that we have gotten the delay down to a minimum, in so far as inspection is concerned, with the present class of equipment.

We have been passing from one condition to another in the car department so rapidly that it is going to take several years to overcome the difficulties that we are experiencing now.

In my early days of car construction we would construct a draft arm out of 3½ by 3½ timber, while now it is almost impossible to get a stick of timber large enough (considering space) that will stand the shock which they are now subjected to.

This is only an example to compare the car construction of today with that of previous years.

This has been caused by the heavy motive power and heavy car equipment that the railroads have been compelled to adopt to transport the commodities of the country and to be able to meet the obligations (caused by the increase of salaries of the employes and the legal restrictions the local and federal authorities laid upon them).

This, in a few years, will be overcome when all of the railroads of the country are able to replace their wooden cars with steel equipment of sufficient strength to withstand the strain put on them.

Any railroad official will tell you that they are interchanging cars in accordance with M. C. B. Rules or, in other words, they will tell you that they want to live strictly up to the M. C. B. Rules.

It seems that these rules are subject to as many interpretations as Brigham Young had wives. I have no doubt that a great many of you will say that this is wrong; the rules are so plain that there can only be one way for them to be interpreted.

There never yet has been any rules or laws so plain but what somebody can and will misunderstand them, or see something in them that another fellow does not see; sometimes this is an honest difference of opinion and sometimes it seems that it is a notion taken with the view to see how different they can be from other people. Again it seems that the lenses in our eyes are made so that we cannot see except only on one side, or what is to the advantage of our road on any particular case.

You may take a case out on your own line, where there are two inspectors, one inspector working for your line and one representing the other line. The inspectors have gotten into a disagreement regarding the condition of a car.

The car foreman will go to that point and ask his inspector what is the trouble. The inspector will tell his foreman that the car has three broken sills, the foreman will examine the car and find three of the sills with a crack from one-half inch to one inch at or near the transom and he will tell his inspector that these are not bad enough for repairs.

His inspector's answer to this will be that he has been compelled to card for such defects as these all the time, since the present rules were in force, and the other inspector's foreman upholds his inspector in setting out such cars and that they will not accept the cars without a defect card.

The foreman will take the side of his inspector and tell his master mechanic that the car should be carded and that the defects are of such a nature that they have been carding for all of the time. Finally the case is settled by the other fellow carding the car, after the car has been delayed some three or four weeks. This, of course, makes the inspector of the delivering line mad and causes him to become more technical in his inspection to enable him to get even with the other line, while the inspector who will gain his point sticks a feather in his hat and goes around and says, "I told you so."

Now this is bad for efficiency; it causes delay and delay to cars is the worst enemy the transportation department has to fight.

Some people will tell you that, according to M. C. B. Rules, it is necessary for the delivering line to inspect and set out all cars for repairs or transfer and card for delivering line defects that are safe to run before the cars are delivered.

Others will tell you that you must set all of your cars for interchange on a certain or delivery track, when the cars will be inspected by the receiving line and after inspection the delivering line must come back and take out all of the cars for repair or transfer, take the cars marked shop to the shop or repair track, those marked transfer to the transfer track, which must be located in the delivering line yard, put defect cards on all cars that are required.

* A paper delivered before the Cincinnati Railway Club.

Others will tell you that what is known as Twentieth Century Inspection is M. C. B. Rules.

Now let us see if we cannot get at a common understanding of this particular matter and avoid any confusion by seeing what the rules say.

The preface of M. C. B. Rules says in substance, car owners are responsible for ordinary wear and tear in fair service, railroads handling the cars are responsible for damage done to cars by unfair usage, derailment, accident, etc.

The rules then go on to define a large number of defects in accordance with the preface.

The M. C. B. Rules are given us as a basis on which to work. The writer takes the stand that it does not matter where a car is inspected, whether in the delivering or receiving line's yard, as may be agreed upon by the roads in interest. Sometimes local conditions determine this question so there can be no hard and fast rule about that.

It is understood that the delivering line is held responsible for any damage that may have been caused to cars by unfair usage, derailment or accident, or any missing material that cannot be charged to the owners of cars in interchange.

Let us take the situation at Cincinnati. The majority of interchange is made through switching lines or through two or three yards by the delivering line, the distance between some of the delivering line and receiving line yards being twenty-six miles.

There are several methods by which inspection and interchange could be made, all of which the writer claims is within the scope of M. C. B. Rules.

First.—It could be made by the receiving lines putting their inspectors in the delivering line's yard and after the cars were side carded, inspecting and marking out such cars that they want repaired, transferred or carded. Cars passing the inspectors as O. K. for service could be switched out and delivered to the receiving line.

Second.—Cars could be inspected by the delivering line's inspectors and cars that they think should be repaired or transferred and defects that they think should be carded for, should be carded and delivered to the receiving line.

Third.—The inspectors could be placed under the Chief Interchange Inspector, cars inspected in the delivering line yard, cars that are required to be set out could be marked out, those requiring repairs could be repaired, those requiring transfer could be transferred and those requiring cards could be carded.

Fourth.—Cars could be given a safety inspection in the delivering line yard by the delivering line's inspectors to see that the cars are safe to go to the repair or transfer track of the receiving line, when they are delivered in the receiving line's yard they could be inspected by the receiving line's inspectors, cars that require repairs and transfer are set out for necessary work and the cars requiring defect cards could be carded.

Now let us see the advantages and disadvantages of these different plans.

First system.—It would be necessary for the line to have twice as many inspectors or more than would be required under the other plans, as no road would agree to have a car inspected in a foreign yard and then switched and handled by a foreign road, without again being inspected when received in their yard.

You would have the advantage of having all bad order cars set out in the delivering line yard, consequently, you would only receive good cars or only such bad order cars as were made such after inspection.

Again, it should be taken into account that no inspector would take any responsibility if he was placed in the delivering line yard and if there was any question at all he would set the car out. His foreman would not take any great exception to this, for if the delivering line foreman would come to him and tell him that his inspectors were too close, the only answer he would get would be that "they were not any closer than your inspectors, for your inspectors are doing the same in my yard, and when you have your inspectors set out only such cars as should be set out, I will have my inspectors do the same thing." The consequence would be, if you did not have a Chief Interchange Inspector or assistants located in each yard both day and night, your line would be blocked in twenty-four hours with cars that the receiving line's inspectors had set out for repairs or transfer, when in fact a great number of them should not have been set out but should have been on their way to destination.

You have delayed freight, caused extra switching and, consequently, created additional expense, and also created a feeling with the shipper that you had not attempted to give him the proper service.

Second system.—It has never been found that the delivering line will inspect and card all cars that the receiving line wants carded or set out all cars that the receiving line thinks should be set out, either for transfer or repairs, nor will they card all cars for defects that the receiving line wants carded for.

This system has been tried at every large interchange point in the country and has never proved satisfactory.

You have all of the work to do over, as you are not satisfied that the other fellow has given you all that you should have had and as you have to answer for the safety of equipment going over your line, you want to know positively that it meets all requirements and will have your own men inspect the cars as they come to you.

Third system.—This does not always prove satisfactory as the men you employ are under another man's jurisdiction and supervision and you are not always able to get results that you require, for the instructions that you require for your particular line are not always carried out in the manner you desire. The instructions issued to inspectors are of a general nature and about on a par with what all the roads require. In this way you have your work to do over for about the same reasons as given in the second system.

Fourth system.—This has some disadvantages but in the writer's opinion has a great many advantages over all of the other systems.

You have the disadvantage of bad order cars coming to your line either for repairs or transfer, which is offset by the cars in the same condition going from your line to the other line.

The advantages are numerous: You have the advantage of having your own inspectors in your own yard directly under your own supervision and you can require them to use their judgment, according to the instructions given by you in the marking out of cars for repairs or transfer.

Every car that they mark out is brought to the immediate attention of the car foreman and every car that they mark out that should not be marked out, you have the remedy which you can apply directly. The consequence is that they do not mark any cars out that you do not want marked out and in this manner save a lot of extra switching and confusion.

Again, if a car should have a cotter key out or a key bolt, or other slight repairs, which the inspectors could make in less time than they could mark the cars out, you will have them make these repairs, but if the car was in the other person's yard the inspector would make the claim that he was sent there to inspect cars and not to repair them.

The fourth manner, as described above, is the way that the interchange is done at Cincinnati, as it is believed to have accomplished the best results, keeping the cars moving with as little loss of time and not setting cars out that do not require setting out, only setting out such cars that are liable to cause damage, the inspectors in the receiving line yard

carding for all defects on cars that they do not wish set out.

The assistant chief interchange inspector visiting each yard each day and carding all cars set out for repairs, combinations and heavy defects.

This manner of carding has been in effect a little over a year and while there have been some cases where the inspectors have been wrong, where we have been compelled to give rebuttal cards to straighten out the trouble, I have the first case to find where the inspector wilfully misused the cards.

There is no set back of cars for bad condition, except through instructions of the chief interchange inspector, which consequently put the set back cars at a minimum.

This manner of interchange is believed by the writer to be the best system of interchange in the country today, as there is less friction and contentions than we have ever had with any other system that has been tried at this point, and I believe that it compares favorably with any other large interchange point in the country and it does not deviate from the principles as laid down by the M. C. B. Rules.

PACIFIC TYPE LOCOMOTIVES, DULUTH, MISSABE AND NORTHERN RY.

The Duluth, Missabe and Northern Railway operates a passenger service between Duluth and Missabe range points, over a line having maximum grades of 3½ per cent. Stops are frequent, and with heavy trains the requirements call for locomotives having not only high starting tractive force, but also steaming capacity. Since 1906 the Baldwin Locomotive Works has built a number of ten-wheeled locomotives for this class of service, and they have recently completed three Pacific types of greatly augmented power, as the following table shows:

Type	Cylinders	Drivers. Diameter.	Steam Pressure.	Grate Area	Water Heating Surface
Ten-wheeled	20″x26″	67″	200	42.5	2,512
Pacific	25″x28″	69″	190	58.6	3,172

	Superheating Surface	Weight on Drivers	Weight, Total	Engine Tractive Force
Ten-wheeled		120,320	163,960	26,400
Pacific	721	155,100	245,700	39,000

The total equivalent heating surface of the new locomotives, making the usual allowance for the superheater, is 4,253 square feet. For an increase in tractive force of 48 per cent there is thus an increase in total heating surface of 69 per cent; and this is acomplished with an increase in total weight of 50 per cent. The difference in the wheel arrangements accounts for the relatively high increase in total weight as compared with tractive force, but this is more than compensated for by the higher relative steaming capacity of the larger engine, as illustrated by the increase in heating surface.

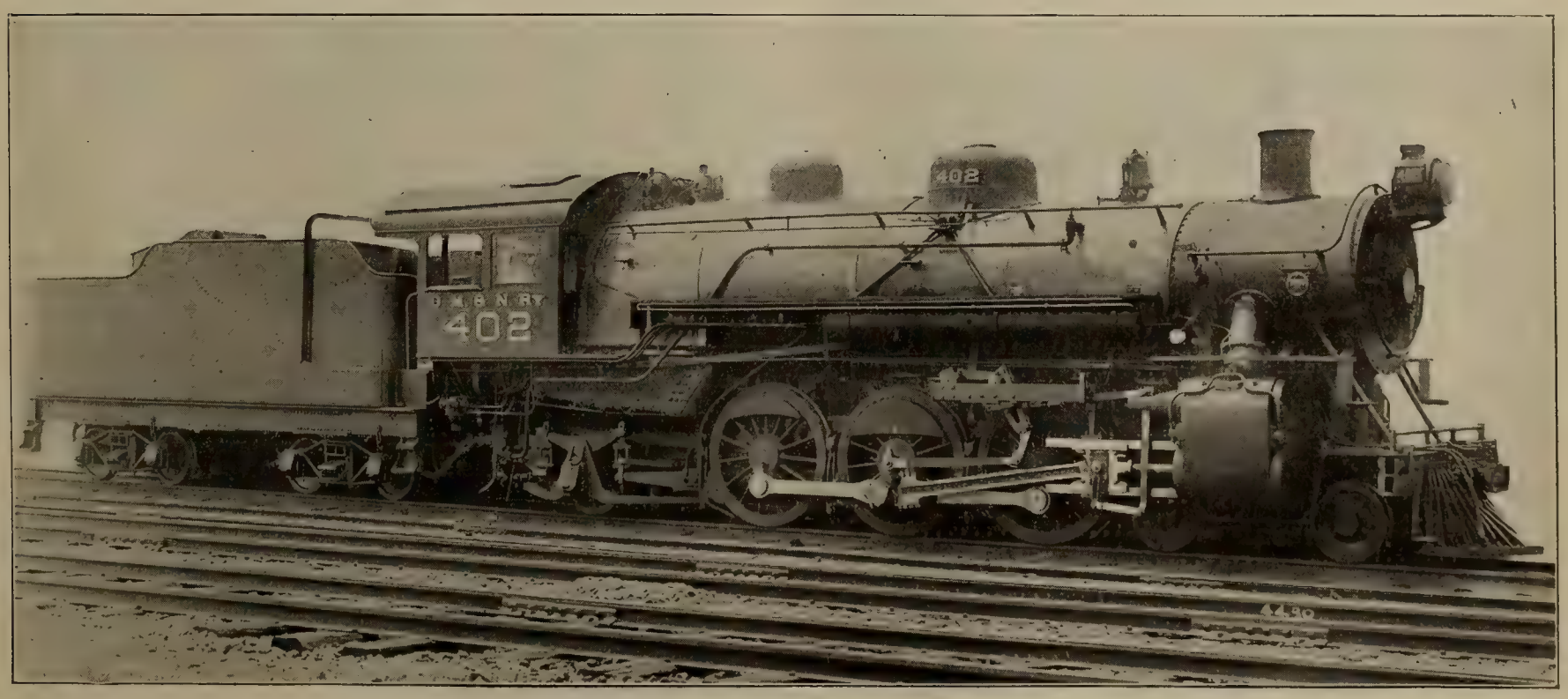
The boilers of the Pacific type locomotives are of the extended wagon-top type, equipped with Schmidt superheaters and Security sectional arches. The superheater is composed of 30 elements, and is arranged with outside steam-pipe connections to the steam chests. A special feature of the boiler equipment is the Seddon boiler feeding device, which has been developed by C. W. Seddon, superintendent of motive power of the Duluth, Missabe and Northern. The water is sprayed into the boiler near the front end, falling into a pan which is fitted tightly against the shell at each side. The front wall of the pan is lower than the back wall, so that the water overflows into the boiler at the greatest possible distance from the firebox. The pan is so sloped that all deposit accumulates in one corner, from which it can be easily removed through a suitable cleaning hole. This device has proved most effective in preventing deposits of scale on the boiler sheets and tubes.

The steam distribution is controlled by 15-inch piston valves, which are of the built-up type and are driven by Walschaerts motion. The main frames are cast in one piece with the front sections. They are 5 inches wide throughout, and 10 inches deep at the cylinder fit; and are strongly braced transversely at the first driving pedestals and also mid-way between adjacent pairs of pedestals. The trailing truck is of the improved Hodges type, designed to dispense with crossbeams under the frames so that more room is obtained for the ash pan. The back equalizing beams are placed diagonally, and connect directly with the truck spring links. The rear links of the truck springs are pinned to brackets which are bolted to the engine frames. This is a simple pattern of truck, having all its parts accessible and so designed as to obstruct the space between the engine frames as little as possible.

Both front and back trucks are braked, in addition to the drivers. This is an excellent feature, especialy in view of the heavy grades on which these engines will be used.

The tenders are carried on arch bar trucks, and the longitudinal frame sills consist of 13-inch channels. The tank is of the water bottom type, with a coal pusher in the fuel space.

These locomotives are excellent representatives of a type



Pacific Type Locomotive, Duluth, Missabe, & Northern Ry.

suitable for the development of high powers at moderate speeds. The engines have been specially designed to meet the conditions existing on the Missabe road, and their successful performance in service may be anticipated.

Gauge	4′ 8½″
Cylinders	25″x28″
Valves	Piston, 15″ diam.

Boiler.

Type	Wagon-top
Diameter	74″
Thickness of sheets	¾″ and $\frac{13}{16}$″
Working pressure	190 lbs.
Fuel	Soft coal
Staying	Radial

Fire Box.

Material	Steel
Length	111″
Width	76″
Depth, front	78¾″
Depth, back	75¼″
Thickness of sheets, sides	$\frac{7}{16}$″
Thickness of sheets, back	$\frac{7}{16}$″
Thickness of sheets, crown	$\frac{7}{16}$″
Thickness of sheets, tube	½″

Water Space.

Front	4½″
Sides	4½″
Back	4½″

Tubes.

Material	Steel
Diameter	5½″ and 2¼″
Thickness	5½″, No. 9 W. G. 2¼″, No. 10, W. G.
Number	5½″, 30; 2¼″, 177
Length	20′ 0″

Heating Surface.

Fire box	206 sq. ft.
Tubes	2936 sq. ft.
Firebrick tubes	30 sq. ft
Total	3172 sq. ft.
Grate area	58.6 sq. ft.

Driving Wheels.

Diameter, outside	69″
Diameter, center	62″
Journals, main	10½″x12″
Journals, others	10″x12″

Engine Truck Wheels.

Diameter, front	33″
Journals	6″x10″
Diameter, back	42″
Journals	8″x14″

Wheel Base.

Driving	12′ 6″
Rigid	12′ 6″
Total engine	33′ 0″
Total engine and tender	65′ 8¼″

Weight.

On driving wheels	155,100 lbs.
On truck, front	44,600 lbs
On truck, back	46,000 lbs.
Total engine	245,700 lbs.
Total engine and tender, about	400,000 lbs.

Tender.

Wheels, number	8
Wheels, diameter	33″
Journals	5½″x10″
Tank capacity	8,000 gals.
Fuel capacity	14 tons
Service	Passenger

Engine equipped with Schmidt superheater.
Superheating surface, 721 sq. ft.

COLE DRIFTING VALVE FOR LOCOMOTIVES.

By Fred H. Hayn, M. E.

The introduction of superheaters on locomotives has given rise to several problems, the greatest, perhaps, being that of the lubrication of the engine cylinders, especially when the locomotive is ''drifting''—that is, moving down grade with throttle closed. The high temperature of the superheated steam admitted to the cylinders causes the oil to dry up, resulting in excessive wear on the packing rings and cylinder rubbing surfaces.

This wear is materially greater when the steam is shut off by the closure of the throttle valve, and the locomotive is drifting, that when steam is passing through the valve chests and cylinders under ordinary conditions. This is due to the fact that, in the latter case, the exhaust steam carries off the excess heat produced by the friction of the wearing parts and keeps their temperature within reasonable limits.

It is clear, then, that the friction of the valves and pistons, even when superheated steam is not used, when the steam is shut off and the locomotive is drifting down long grades, produces considerable heat, whereby the temperature of the wearing parts is abnormally raised, resulting in undue wear; and this, notwithstanding the fact that the quantity of oil used may be precisely the same as when running under ordinary conditions.

When, then, locomotives are equipped with superheaters, it is manifest that the problem of lubrication is much more serious. The various parts subject to wear are much hotter than in locomotives using saturated steam; and, consequently, even a smaller increase in temperature due to friction is much more quickly effective in the wear of the cylinders, packing rings, bushings, etc., than when saturated steam is used.

Sudden changes of temperatures, too, caused by letting cold air into the cylinders, when the locomotive is drifting, causes unequal contraction or shrinkage, and many times results in fracture or cracking of the cylinders. This fracture or cracking occurs usually through the saddles and also results in a loosening of the bolts in the frame.

The dust and soot of the products of combustion are drawn into the cylinders, when drifting, resulting in the early cutting out of the valves, pistons, cylinders, packings and rods. This is due, as is obvious, to the pumping action of the pistons.

On account of these objectionable results it has been customary to slightly ''crack'' the throttle valve, when drifting down long grades, in order to permit a small quantity of steam to enter the valve chests and cylinders.

A patent granted as far back as 1874, suggested this idea; and another patent was issued in 1902 along similar lines. The railroads of this country, however, did not take kindly to this practice, for obvious reasons, especially in the case of locomotives equipped with superheaters, by reason of the high heat of the superheated steam admitted to the cylinders.

The evil results of permitting soot, gases, etc., to enter the engine cylinders and valve chests, together with the effects of the sudden changes of temperature caused by the cold air, have long been known. And for this reason, vacuum valves have been usually provided on the valve chests. The function of these valves is to admit a quantity of air to the cylinders, in order to reduce the vacuum therein and prevent the hot gases and cinders from being drawn from the smoke box into the exhaust pipes. The area of these valves is necessarily so small that it is impossible to supply air in sufficient quantities to prevent the production of a partial vacuum, and, accordingly, by-pass valves are usually supplied to assist in the prevention of the vacuum.

The problem of lubrication in a locomotive equipped with super-heaters seems to have been solved in a recent patent granted to Francis J. Cole, of the American Locomotive Works, of Schenectady, N. Y. This patent shows a simple and inexpensive device for automatically admitting a limited quantity

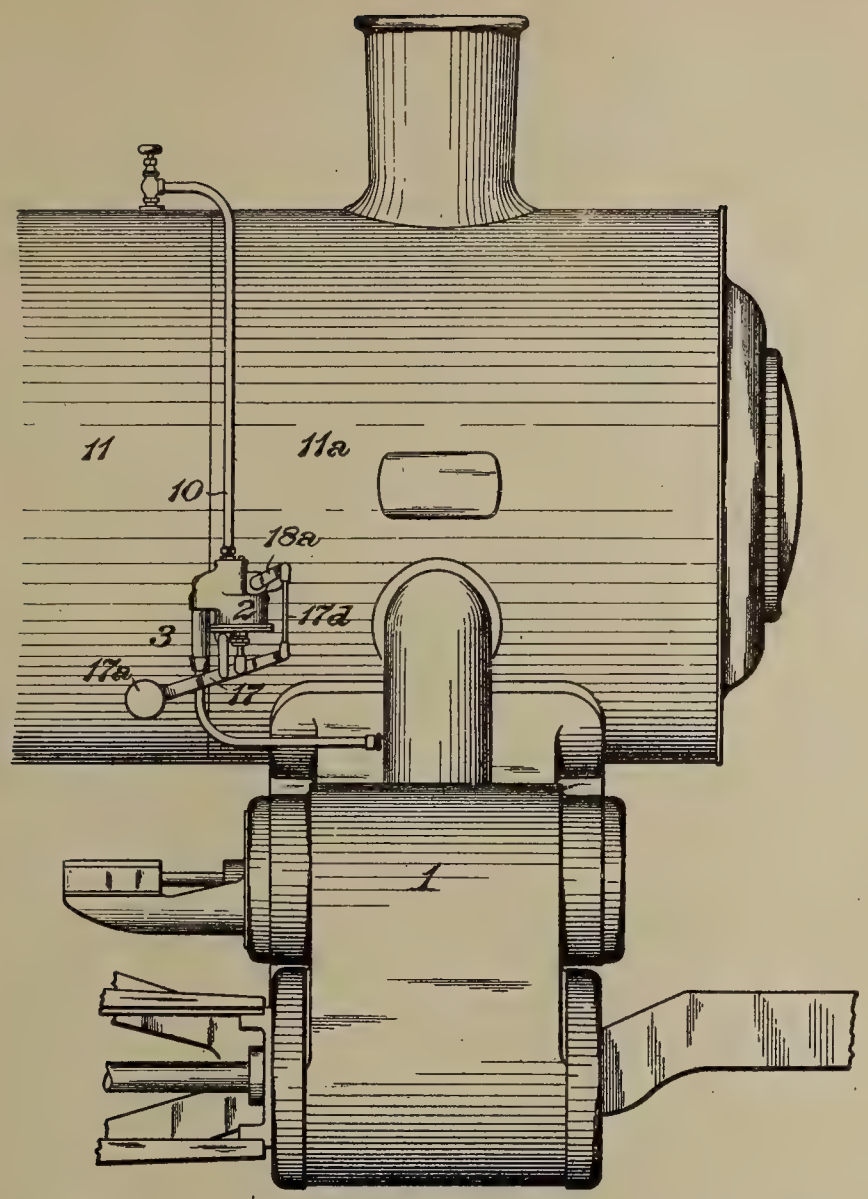


Fig. 1. Cole Drifting Valve as Applied to Locomotive.

of steam, directly from the boiler to the valve chests when the locomotive is drifting.

The device, which is shown applied to a locomotive in Fig. 1, is especially designed for operation on a locomotive fitted with superheaters, and it performs the additional function of automatically operating the superheater damper.

The device is conveniently placed adjacent the valve chest, a separate device being placed adjacent each chest on each side of the locomotive. It consists of a piston chamber 2, which contains a piston 4, provided with suitable packing rings 4a. The lower end of the chamber is closed by a removable head 5, having one or more air openings 5a, which may, if desired, be piped to any location at which dust is not liable to enter, as indicated in Fig. 2.

A piston rod 4b, passes through a properly packed stuffing box 5b, in the head 5. This piston rod is turned down at and for some distance from its upper end, to provide a shoulder 4c, which abuts against an annular stop 5c, formed centrally on the head 5, and thereby limits to the proper degree the upward traverse of the piston rod. The upper end of the piston rod abuts against the closed lower end of the socket 4d, formed centrally on the piston.

A lever 17, having a weight 17a, fixed on one of its ends, is fulcrumed through a link 17b, on a pin 17c, fixed in the lugs 5d, on the lower side of the head 5; and the opposite end of the lever 17, is coupled by a link 17d, to an arm 18a, on one end of the shaft 18, of the superheater damper, which shaft is in ordinary practice journaled in bearings in the smoke box 11a, of the boiler 11, of the locomotive. The lever 17, is also coupled by a pin 4e, to a jaw 4f, on the lower end of the piston rod 4b, this connection being made between the links 17b and 17d.

Under the construction just described, downward movement of the lever 17, to the left, which is effected by the downward movement of the piston 4, will swing the superheater damper shaft 18, in direction and extent to close the superheater damper, and movement of the lever in the opposite direction, which is effected by the gravity of the weight 17a, will swing the shaft 18, in direction and extent to open the superheater damper.

A steam supply chamber 6, and steam delivery chamber 7, are fixed to the top of the piston chamber 2, being preferably, as shown, formed intergral therewith, and being separated by a partition 8, in which there is formed an opening controlled by a steam supply valve 9, of the puppet type, which seats downwardly, or in the direction of the steam delivery chamber 7. A passage 2a, leads out of the upper end of the piston chamber 2, and is connected by a pipe 3, with the adjacent distribution valve chest 1. The steam supply chamber 6, communicates by a pipe 10, with the steam space of the boiler 11, and a pipe 12, leads from the steam delivery chamber 7, into the pipe 3, leading to the valve chest, within which pipe it terminates by an open end, a short distance, as, say, about five or six inches below the passage 2a; this relative disposition of the pipes 12 and 13 being made for the purpose of enabling the former to act in the manner of a jet nozzle for momentarily inducing an increase of vacuum above the piston 4.

A piston 13, of materially greater diameter than that of the steam supply valve 9, is fitted in the chamber 13a below, and substantially in line axially with said valve, the top of the piston being normally in contact with or slightly below the downwardly projecting stem 9a, of said valve, so as to be adapted to unseat it by its upward movement. A passage 14, leads from the steam supply chamber 6, to the piston chamber 13a, said passage being controlled by a small pilot valve 15, the stem 15a, of which extends downwardly to or near the bottom of the central socket 4d, of the piston.

The operation of the appliance is as follows:

Let it be assumed that the locomotive is standing and the throttle to be opened; steam is admitted to the distribution

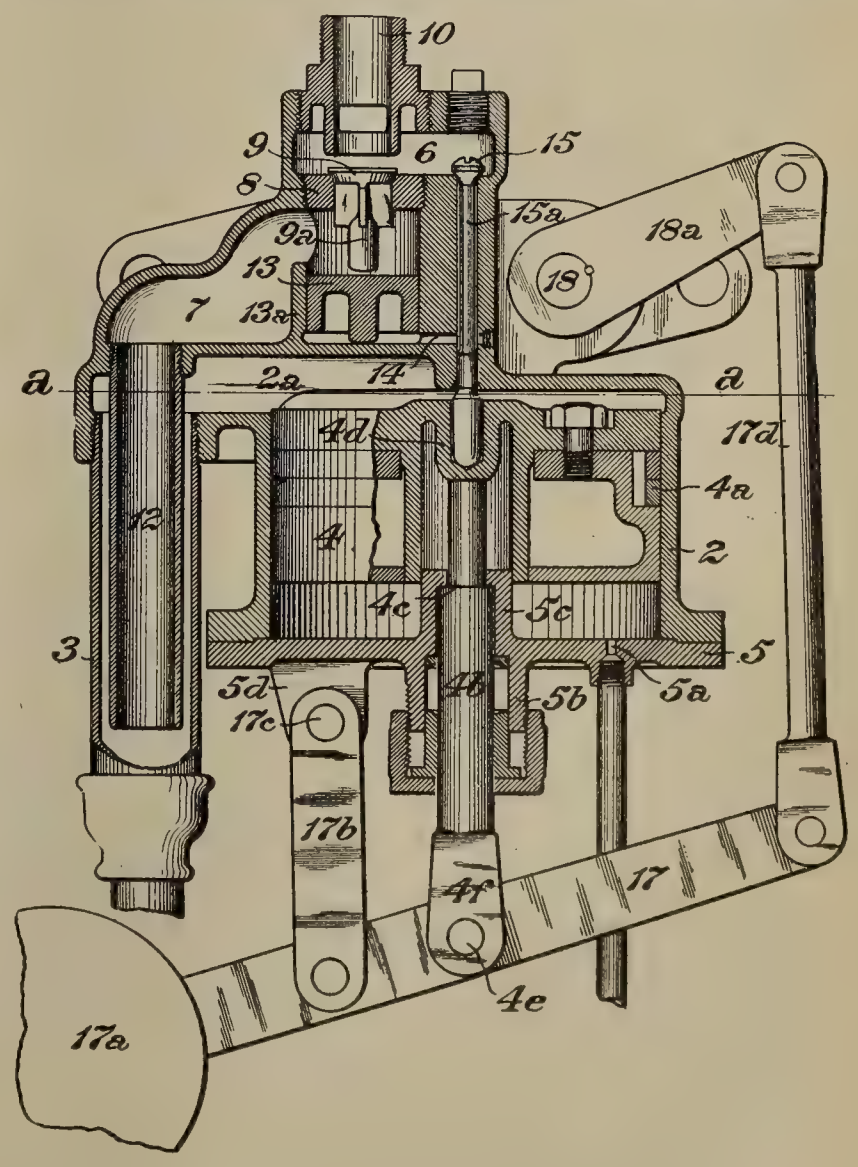


Fig. 2. Sectional View of Cole Drifting Valve.

valve chests, and thence through pipes 3, to the piston chambers 2, above the pistons 4, forcing said pistons downwardly and through their connection with the superheater damper shaft 18, opening the superheater damper. When the throttle is closed, the weights 17a, force the pistons upward and close the superheater damper.

When the engine is drifting with throttle closed, especially on long grades, the weights force the pistons upward until the motion of the piston rod is arrested by the contact of its shoulder 4c, with the stop 5c, thereby preventing further movement of the superheater damper shaft. A partial vacuum being formed in the valve chests by the movements of the pistons therein, as previously described, a corresponding reduction of pressure results in each of the piston chambers above the piston 4, thereof, which is thereupon forced upwardly by the higher atmospheric pressure below it, of the air which enters through the opening 5a.

The upward movement of the piston unseats the pilot valve 15, thereby admitting steam from the pipe 10, and chamber 6, to the piston chamber 13a, below the piston 13. The said piston is thereby moved upwardly, unseating the supply valve 9, and admitting steam from the boiler through the pipe 10, chambers 6 and 7 and pipes 12 and 13, to the valve chest. The jet action of the downwardly extending pipe 12, induces momentarily, an increased vacuum above the piston.

When the throttle is opened for the purpose of working the locomotive under steam, the piston 4, is depressed by the then higher pressure above it, and the valves 15 and 9 are seated by the same higher pressure, the parts being thereby returned to the normal positions shown in Fig. 2.

The above described device has proven a reliable one and is being rapidly placed on all the locomotives equipped with superheaters, turned out by one of the large locomotive works.

THE SAFETY FIRST EXHIBIT CAR of the New York Central Lines is being taken all over the lines and was on exhibition at Chicago from September 22 to 24. It is playing a prominent part in the Safety First campaign of the New York Central in the education of both employes and the public. The car is in charge of an instructor and contains many models showing methods of safeguarding machines, together with a large number of photographs illustrating safe and unsafe practices.

New Books

WATER, ITS PURIFICATION AND USE IN THE INDUSTRIES. By W. W. Christie. Cloth, 5½"x8", 220 pages, illustrated. Published by the D. Van Nostrand Co., 25 Park Place, New York. Price $2.00.

The greater portion of the material in this book ran in a series of articles in "Industrial Engineering and Engineering Digest" during 1910 and 1911. Practically the entire book is devoted to the use of water for manufacturing and railway purposes, although a portion is devoted to drinking water filters and sterilization of water. The opening chapter defines the various impurities of water included in the carbonates, nitrates, chlorides and sulphides, and in brief gives the requirements for the water used in various industries. There are two systems of water softening, the hot process and cold process systems. In the cold process there are two types, the intermittent and the continuous. A description, together with illustrations, of all the various types of water softeners is given, bringing out the principal features of each. The names of the manufacturers have been omitted, although the writer states that as far as possible the descriptions have been submitted to and approved by the makers.

A short chapter following gives a few results accomplished by water softening. It would seem that this section could have been made more elaborate and interesting, as the results given only cover about five pages. Such data as it contains deals mostly with laundries, no results of the use of plants on railways being given.

The measurement of water by liquid scales, by tipping weighers, by weirs and by the Venturi meter is briefly described and the concluding chapter takes up oil in boiler water and methods of removing it. The book contains about 80 illustrations including a number of colored inserts which are of great assistance in following the course of water through the softener. It covers the subject of water softening very well on the whole and is recommended to anyone who wishes to obtain a knowledge and the general principles and operations involved in treating water.

RULES OF MANAGEMENT. By William Lodge. Cloth, 5"x7½", 140 pages, unillustrated. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price $2.00.

The author of this book is the president of the well-known Lodge & Shipley Machine Tool Co. In the foreword the author states that the time comes to every man at the head of a large industrial establishment when he must turn over the management to some one else and that before he turns over the reins he must have taught those under him how to drive. In doing this in his own plant, Mr. Lodge first wrote these chapters to give information to the succeeding managers of his shops. They are chapters covering his personal experience as manager.

The book first takes up the duties of the general manager and continues down through the line to janitors and watchmen. For instance, it outlines the duties of the chief engineer, the purchasing agent, the tool room, the lathe department, the sales manager and the shipping clerk. The book of course follows through the particular organization of the Lodge & Shipley Machine Tool Co. with the view of giving to the organization in written form a knowledge of facts which Mr. Lodge found in his long career to be sound.

While this book is confined to one particular organization and one which of course is somewhat different from a railway organization, it is written by a man who built up a highly successful organization and outlines that organization. A successful institution is worth studying and Mr. Lodge has put one in book form.

MASTER BOILER MAKERS' ASSOCIATION. Proceedings of the seventh annual convention. Paper, 6"x9", 175 pages, illustrated. Published by the secretary, Harry D. Vought, 95 Liberty St., New York. Price $1.00.

This volume embodies the official proceedings of the convention held at the Hotel Sherman, Chicago, Ill., May 26, 27, 28 and 29, 1913, an outline of which was published on page 242 of the June issue of the *Railway Master Mechanic*. Beside the routine business of the association and a number of addresses given before the meeting, the proceedings contain committee reports on a number of subjects connected with railway boiler shops, together with the discussion of same by the members. Among the subjects discussed were "Welding Superheater Flues," "Effect of Superheaters on Fireboxes and Flues," "Oxy-acetylene and Electric Welding Processes," "Boiler Inspection," "Benefits Derived from Chemically Treated Water," "Best Form of Grate," "Best Method of Applying and Taking Care of Flues," "Limitation of Tube Lengths Without Midway Supports." This association has between three and four hundred members.

FACTORY LIGHTING. By Clarence E. Clewell. Cloth, 6½"x9", 161 pages, illustrated. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price $2.00.

The question of shop and factory lighting is one which until very recently has been given but little attention and even at the present time it is given but scant attention in many shops. However, officials are beginning to realize that there is a con-

nection between a well-lighted shop and the efficiency of the men who work in it. The "safety first" movement has also helped to bring this subject to the front, for as pointed out in this journal a number of times, the percentage of shop accidents during the months of minimum daylight is considerably higher than it is during the summer months. Therefore this is a timely subject.

Some of the material in this book has been selected from papers which the author has written for various technical journals. The author has been engaged in the design and supervision of the installation of lighting systems for a number of years and has spent most of his time with the Westinghouse people, so he is amply qualified to cover the subject. He has not confined his work to any particular class of factory or shop and the book is equally interesting and instructive to the manufacturer or the railway man. The opening chapter gives general items with regard to lighting including an interesting sketch giving names, external appearance, overall dimensions and candle power ranges of all the various types of lamps. Following this are two chapters on illumination design and installation work, which are quite complete in information with regard to spacing, height, switch control, cost estimating, lamp supports and circuits. This is followed by a chapter on lighting maintenance and records. Two chapters are devoted to office and drafting room lighting with many illustrations showing good and bad methods of placing lights.

The chapters covering placing of the lights in the shop and power house bring out very well the economy of a well-lighted work room and give a number of illustrations with regard to correct placing. One of the most interesting chapters is that on machine tool lighting. The author advocates lighting the machine tool by lamps separate and apart from the machine whenever possible and urges that the operator be given sufficient light, pointing out the comparatively negligible cost of supplying it. It is possible that the author could have gone further into this last subject, however.

The book is well worth reading and the mechanical or electrical engineer who is planning the lighting for a new shop or improving an old system will find this book very instructive.

Personals

WALTER BUDWELL succeeds E. J. Nunan as foreman of the Norfolk & Western at East Radford, Va.

E. J. NUNAN succeeds J. H. Ramsey as foreman of the Norfolk & Western at Shenandoah, Va.

N. L. SMITHAM has been appointed master mechanic of the Missouri, Kansas & Texas at Waco, Tex. He succeeds H. L. McLow.

F. RUTLEDGE has been appointed road foreman of engines of the Missouri, Kansas & Texas, with office at Greenville, Tex.

H. HONAKER, master mechanic of the St. Louis & San Francisco, has been transferred from Ft. Scott, Kan., to Birmingham, Ala.

F. A. MCARTHUR, master mechanic of the St. Louis & San Francisco, has been transferred from Springfield, Mo., to Enid, Okla., succeeding J. J. Shaw.

A. S. ABBOTT succeeds F. A. McArthur as master mechanic of the St. Louis & San Francisco at Springfield, Mo.

JOHN FORSTER has been appointed master mechanic of the St. Louis & San Francisco at Kansas City, Mo.

G. R. WILCOX succeeds E. E. Skipton as roundhouse foreman of the St. Louis & San Francisco at Birmingham, Ala.

A. E. HALE succeeds H. L. Moore as roundhouse foreman of the Southern Pacific at Tucson, Ariz.

W. L. ESSEX has been appointed master mechanic of the Arkansas, Louisiana & Gulf. His office is at Monroe, La.

R. B. SPENCER has been appointed general foreman of the Atlantic Coast Line at Savannah, Ga. He succeeds M. N. Diefenderfer.

A. J. EICHENLAUB succeeds F. W. Beardman as general foreman of the Baltimore & Ohio Southwestern at Washington, Ind.

A. E. MCMILLAN succeeds A. J. Eichenlaub as general foreman of the Baltimore & Ohio Southwestern at Cincinnati, O.

W. C. GARAGHTY has been appointed road foreman of engines of the Baltimore & Ohio Southwestern at Cincinnati, O.

ELMER E. COPE has been appointed road foreman of engines of the Buffalo, Rochester & Pittsburgh, with office at DuBois, Pa. He succeeds James Spellen.

J. P. MCANANY succeeds G. Whiteley as district master mechanic of the Saskatchewan division of the Canadian Pacific, with office at Moose Jaw, Sask.

F. G. WHITELEY has been appointed master mechanic of the Alberta division of the Canadian Pacific, with office at Calgary, Alta.

G. GLASSFORD has been promoted from road foreman to district master mechanic of the Alberta division of the Canadian Pacific. His office is at Calgary, Alta.

G. MOCK succeeds M. J. Scott as district master mechanic of the British Columbia division of the Canadian Pacific, with office at Revelstoke, B. C.

W. H. EVANS has been appointed district master mechanic of the British Columbia division of the Canadian Pacific, with office at Vancouver, B. C.

A. A. HARRIS succeeds E. S. Eden as master mechanic of the Central New England at Hartford, Conn.

J. A. BARKER has been appointed road foreman of engines of the Chesapeake & Ohio of Indiana, with office at Peru, Ind.

H. G. KASLIN, master mechanic of the Chicago, Burlington & Quincy, has been transferred from Beardstown, Ill., to LaCrosse, Wis. He succeeds N. Frey.

J. B. ROACH succeeds H. G. Kaslin as master mechanic of the Chicago, Burlington & Quincy at Beardstown, Ill.

H. S. MORED succeeds J. B. Roach as master mechanic of the Chicago, Burlington & Quincy at Aurora, Ill.

D. R. SWENEY succeeds H. S. Mored as master mechanic of the Chicago, Burlington & Quincy at Ottumwa, Ia.

D. R. MCGRATH succeeds H. W. Johnson as master mechanic of the Chicago, Burlington & Quincy at Brookfield, Ill.

C. A. HEALEY succeeds D. R. McGrath as road foreman of locomotives of the Chicago, Burlington & Quincy at Galesburg, Ill.

J. S. FORD succeeds D. R. Sweney as road foreman of engines of the Chicago, Burlington & Quincy at Aurora, Ill.

F. S. RODGER has been appointed assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul, with office at St. Paul, Minn. Mr. Rodger was formerly assistant master mechanic at Green Bay, Wis.

W. H. HART has been appointed assistant master mechanic of the Chicago, Milwaukee & St. Paul at Green Bay, Wis., succeeding F. S. Rodger. Mr. Hart was formerly road foreman of engines at Milwaukee, Wis.

C. LUNDBERG has been appointed assistant master mechanic of the Chicago, Milwaukee & St. Paul at Milwaukee, Wis.

H. A. ENOCKSON has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha, with office at East St. Paul, Minn.

G. H. HOFFER has been appointed division car foreman of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Springfield, O. He succeeds L. G. Heiser.

B. D. MASON succeeds Geo. P. Rattenbury as master painter of the Colorado & Southern at Denver, Colo.

A. STOLL succeeds W. J. Davis as general foreman of the Detroit, Toledo & Ironton. His office is at Lima, O.

W. J. DAVIS, general foreman of the Detroit, Toledo & Ironton, has been transferred from Lima, O., to Springfield, O., succeeding F. T. Wissinger.

G. T. DEPUE has been appointed shop superintendent of the Erie at Galion, O.

R. E. MOLT succeeds S. D. Kidder as locomotive foreman of the Great Northern at Whitefish, Mont.

C. WOLD has been appointed car foreman of the Great Northern at Kalispell, Mont. He succeeds J. F. Bruce.

W. U. APPLETON has been appointed general master mechanic of the Intercolonial, with office at Moncton, N. B.

H. W. SHARPE has been appointed master mechanic of District 1 of the Intercolonial. His office is at Riviere du Loup, Que.

T. W. HENNESEY has been appointed master mechanic of District 2 of the Intercolonial, with office at Campbellton, N. B.

W. E. BARNES has been appointed master mechanic of District 3 of the Intercolonial, with office at Moncton, N. B.

ROBERT QUAYLE, of the Chicago & North-Western, has had his title changed to general superintendent of motive power and car department, having been given charge of both car and locomotive departments. Mr. Quayle says he has no biography—he just grew up. His new title is a fitting recognition of his executive ability.

Robert Quayle.

H. D. MCKENZIE has been appointed master mechanic of District 4 of the Intercolonial, with office at Stellarton, N. S. Mr. McKenzie was formerly general locomotive foreman at Moncton, N. B.

JOS. GRAHAM has been appointed superintendent locomotive shops of the Intercolonial at Moncton, N. B. He succeeds H. D. McKenzie.

GEO. E. SMART has been appointed master car builder of the Intercolonial, with office at Moncton, N. B.

W. J. SHREVE has been appointed master mechanic of the Minnesota, Dakota & Western. His office is at International Falls, Minn.

H. L. MCLOW has been appointed general foreman of the Missouri, Kansas & Texas at Greenville, Tex.

F. G. MOLE succeeds R. F. Miller as storekeeper of the Oregon Short Line at Salt Lake City, Utah.

G. B. KOCH succeeds E. McLean as general foreman of foundries of the Pennsylvania at South Altoona, Pa.

P. R. BINGMAN has been appointed foreman car shops of the Pennsylvania, with office at State Line, Pa. He succeeds L. E. Rush.

L. E. RUSH, foreman car shops of the Pennsylvania, has been transferred from State Line, Pa., to Mifflin, Pa.

E. W. SMITH has been appointed assistant master mechanic of the Philadelphia, Baltimore & Washington, with office at Wilmington, Del. He succeeds B. B. Milner.

W. M. PORTLOCK succeeds H. C. Macklin as purchasing agent of the Seaboard Air Line, with headquarters at Portsmouth, Va.

D. D. CAIN succeeds W. M. Portlock as general storekeeper of the Seaboard Air Line, with office at Portsmouth, Va. Mr. Cain was formerly storekeeper for the Southern Pacific at Los Angeles, Cal.

H. H. PARKER has been appointed general foreman of the shops of the Seaboard Air Line at Portsmouth, Va.

B. E. GREENWOOD, formerly general foreman locomotive department of the Seaboard Air Line, has been promoted to shop superintendent. His office is at Portsmouth, Va., as before.

H. T. BENTLEY, principal assistant superintendent of motive power of the Chicago & North-Western, has been appointed superintendent of motive power, with office at Chicago. Mr. Bentley entered railway service in 1877 with the London & Northwestern Railway of England as an apprentice and machinist. In 1892 he entered the Chicago shops of the North-Western as a machinist and was advanced steadily to his present position. An extended biography of Mr. Bentley is unnecessary; he started at the bottom and has risen to the top. He is a thorough mechanical man and "Bentley will always give you a fair show."

H. T. Bentley.

A. B. MCDONALD has been appointed superintendent car shops of the Intercolonial, with office at Moncton, N. B.

G. M. STONE has been appointed master mechanic of the Chicago, Rock Island & Pacific, with office at Chickasha, Okla., succeeding W. J. O'Neill.

W. J. O'NEILL has been appointed master mechanic of the Chicago, Rock Island & Pacific at Shawnee, Okla., succeeding C. A. McCarthy, resigned.

E. M. SWEETMAN, master mechanic of the Southern, has been transferred from Birmingham, Ala., to Princeton, Ind., succeeding G. N. Howson.

FRANK JOHNSON, master mechanic of the Southern, has been transferred from Sheffield, Ala., to Birmingham, Ala.

J. W. GIBBS has been appointed master mechanic of the Southern at Sheffield, Ala.

E. L. AKANS succeeds J. W. Gibbs as master mechanic of the Virginia & Southwestern, with office at Bristol, Va.

GILBERT DEMPSTER has been appointed master mechanic of the Southern Railway in Mississippi, with office at Columbus, Miss. He succeeds F. E. Patton.

W. J. MCCULLOUGH succeeds D. D. Cain as storekeeper of the Southern Pacific at Los Angeles, Cal.

C. E. DALE has been appointed storekeeper of the Wabash at Ft. Wayne, Ind. He succeeds J. Richards.

F. H. STEPHENS succeeds R. M. Rowley as storekeeper of the Wabash at St. Thomas, Ont.

J. F. ENRIGHT has been appointed superintendent of motive power of the Western Pacific to succeed J. E. O'Brien, who has accepted a position on another road.

J. E. O'BRIEN has been appointed assistant mechanical superintendent of the Missouri Pacific with office at St. Louis, Mo. Mr. O'Brien has been superintendent of motive power of the Western Pacific for the past four years and previous to that served thirteen years in various capacities on the Northern Pacific.

T. G. Armstrong.

GEORGE W. ROBB, as announced in our last issue, has been appointed superintendent of motive power of the Grand Trunk Pacific with office at Transcona, Man. Mr. Robb started railway work in 1881, as an apprentice and later a car repairer on the Grand Trunk. From 1886 to 1888 he was a machinist with the Canadian Pacific at Winnipeg and Brodview, leaving this road to become night foreman on the St. P., M. & M. From 1889 to 1891 he was foreman of the Great Northern at Willmar and Glasgow and from 1891 to 1892 locomotive foreman on the Chicago Great Western at So. Des Moines, Ia. From 1893 to 1895 he was shop foreman on the Canada Atlantic (a Grand Trunk line) and from 1895 to 1907 was general foreman on the same road at Ottawa. In 1908 he was appointed assistant master mechanic of the Grand Trunk Pacific at Rivers, Man., and in 1909 was promoted to master mechanic which position he held until his recent appointment.

G. W. Robb.

M. JEFFERSON has been appointed assistant master mechanic of the Lehigh Valley at Easton, Pa.

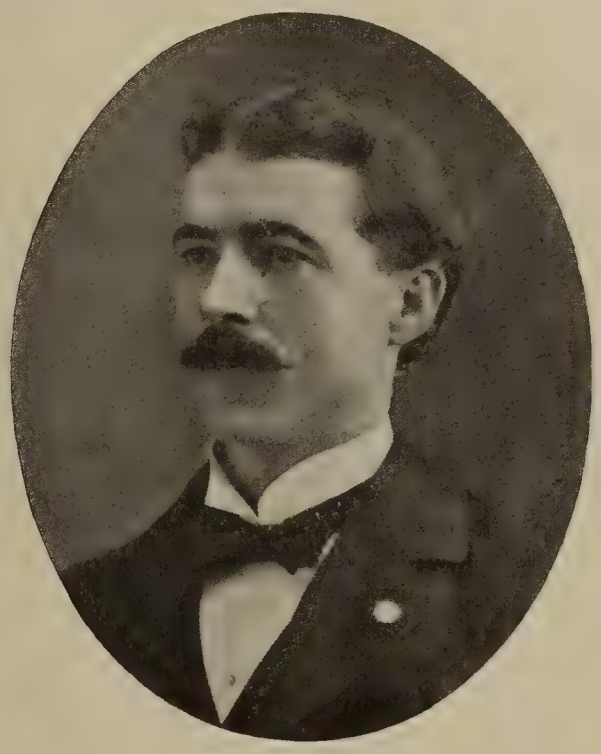
HENRY WITHAM succeeds G. E. Johnson as division foreman of the Atchison, Topeka & Santa Fe Coast Lines at Gallup, N. M.

C. A. MCCARTHY has been appointed master mechanic of the Colorado Springs & Cripple Creek District with office at Colorado Springs, Colo.

N. A. WALDRON succeeds J. M. Gibbons as general storekeeper of the Missouri, Kansas & Texas with office at Parsons, Kan. Mr. Waldron was formerly storekeeper of the St. Louis Southwestern.

T. G. ARMSTRONG has been appointed assistant master car builder, Western Lines, Canadian Pacific. Mr. Armstrong was born in Waterloo, Que., April 30th, 1863, and entered railway service April, 1888, since when he has been bridge foreman on C. P. R. and O. M. R. & Q. C. R. during their construction, and from 1895 to 1902 general contractor and builder. He again entered the service of the Canadian Pacific in 1902, since when he has been to 1906 foreman at Farnham, Que.; from 1906 to 1908, car foreman at Winnipeg, and from 1908 to 1913, general car foreman, which position he resigned to accept his present one.

PHIL F. LANDY has been appointed general foreman of the Baltimore & Ohio Southwestern at Cincinnati, O. Mr. Landy



Phil F. Landy.

began railway work August 15, 1891, as a machinist apprentice in the shops of the Pennsylvania at Cincinnati and at Dennison, O. He left Dennison to go to Richmond, Ind., as head machinist at the shop and roundhouse. From here he was transferred to Ft. Wayne, Ind., and in 1901 was made assistant night roundhouse foreman at this point. Later he was promoted to assistant erecting shop foreman. He was next made piece work adjuster and subsequently became roundhouse general foreman. He left the Pennsylvania to become assistant erecting shop foreman of the Lima Locomotive Corporation which position he resigned to accept his present one.

John R. Swindel.

JOHN R. SWINDEL has been appointed general foreman of the Oregon Short Line, with office at Pocatello, Idaho. Mr. Swindel served his apprenticeship with the Michigan Central and worked as a machinist for this road for three years, leaving to go to the Detroit & Mackinac at Tawas, Mich., and later to the Pere Marquette, at Saginaw, Mich. He then went with the Lake Shore & Michigan Southern as machinist at the new Collinwood shops when they were opened in August, 1902. In March, 1903, he was made assistant machine shop foreman, and in November was made foreman of manufacturing department and millwright gang. In December, 1904, he became shop inspector in charge of piece work inspectors and assistant to the general shop inspector, looking after the locomotive department and installing piece work. In July, 1906, he was made machine foreman, and in November, 1908, was made general machine shop foreman. In March, 1911, he left the Lake Shore to become general foreman of the Missouri Pacific shops at Coffeyville, Kan., and in April, 1912, went with the San Pedro, Los Angeles & Salt Lake, at Las Vegas, Nev., as general foreman. He left this road to go with the Oregon Short Line as roundhouse foreman, and was promoted to general foreman on September 8.

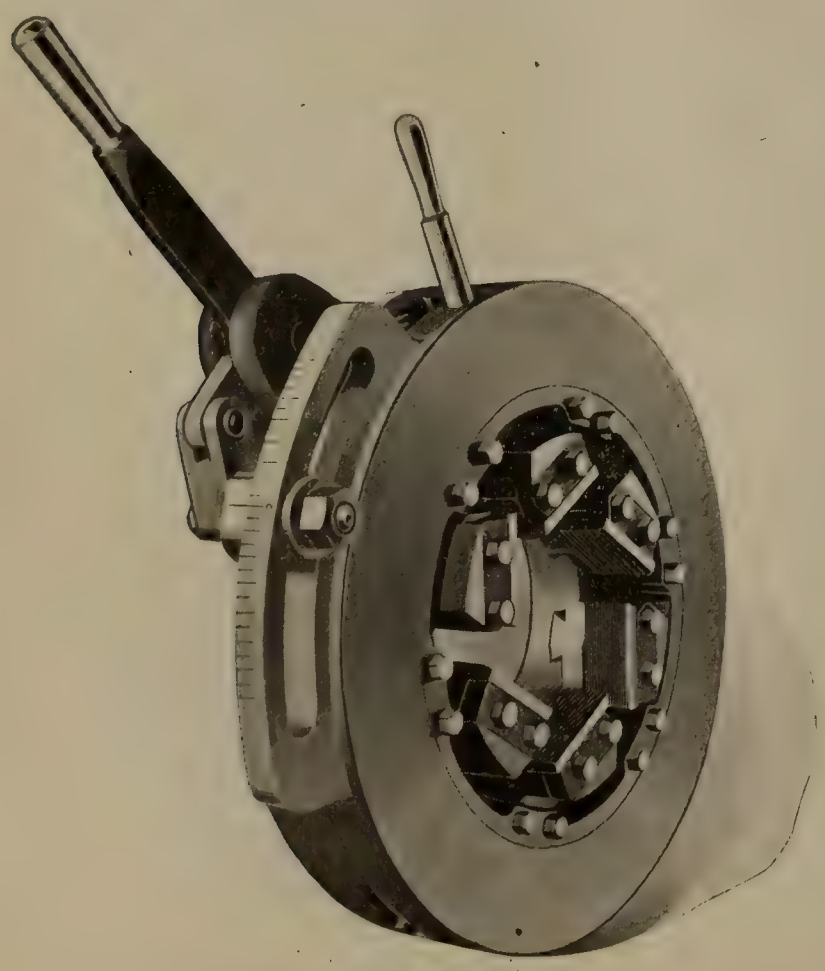
FRANK TEED has been appointed general car foreman of the Baltimore & Ohio Southwestern at Washington, Ind. Mr. Teed began his railroad career with the Pullman Co. at Ludlow, Ky., on September 9, 1896, as a messenger boy. After obtaining a knowledge of car repairing he was appointed mechanical inspector at this point and after a few years was appointed assistant manager, which position he resigned on account of poor health. After a three months' rest he accepted a position at Lima, O., with the Cincinnati, Hamilton & Dayton and on October 15, 1912, he accepted the position of passenger car foreman on the Baltimore & Ohio Southwestern at Washington, Ind., which position he held until his present appointment. Mr. Teed is thirty-one years of age, seventeen years having been spent in railway service.

Among The Manufacturers

LANDIS SIX CHASER STATIONARY PIPE DIE HEAD.

Among the many improvements in machine tools is a new pipe die head, recently placed on the market by the Landis Machine Co., of Waynesboro, Pa. The head is extremely simple in construction and is applicable to certain pipe machines of the rotating pipe type. A general idea of its operation may be obtained from the illustration. As will be noted, the head is composed of four major parts, namely, the head body, which carries the chaser slides, the chaser slides, the operating ring, which imparts the oscillatory motion of the handle to the chaser slide, giving the chasers a universal radial movement to and from the center, and last but not least the long life chasers.

There are several important characteristics of this die that are worthy of note. Its life is ten times that of the ordinary hobbed type die. Moreover the line contact the chasers have with the work reduces the friction to a minimum and permits of much higher cutting speeds. This increase in speed is augmented by the flexible rake feature, which makes it possible to obtain the very best cutting condition and successfully thread all grades of pipe, be it iron, steel, brass or copper.



Landis Six Chaser Pipe Die Head.

Since the lengths of thread on the standard sizes of pipe are fixed, a die that requires grinding in the throat is of little value, as a few grindings will cause the length of thread to fall below the standard. This objection is also eliminated with the Landis die, since the cutting contour is always the same, due to the fact that the chasers are ground on their inner ends and never on the bevel surfaces, which form the throat.

At a recent test made in the plant of one of the largest eastern pipe mills a circumferential cutting speed of forty feet per minute was maintained. This means that the various sizes of pipe were rotated in accordance with the accompanying table:

Size of Pipe.	Rev. Per Min.	Ft. Per Min.
⅜″	227	40
½″	181	40
¾″	144	40
1″	116	40
1¼″	98	40
1½″	79	40
2″	64	40

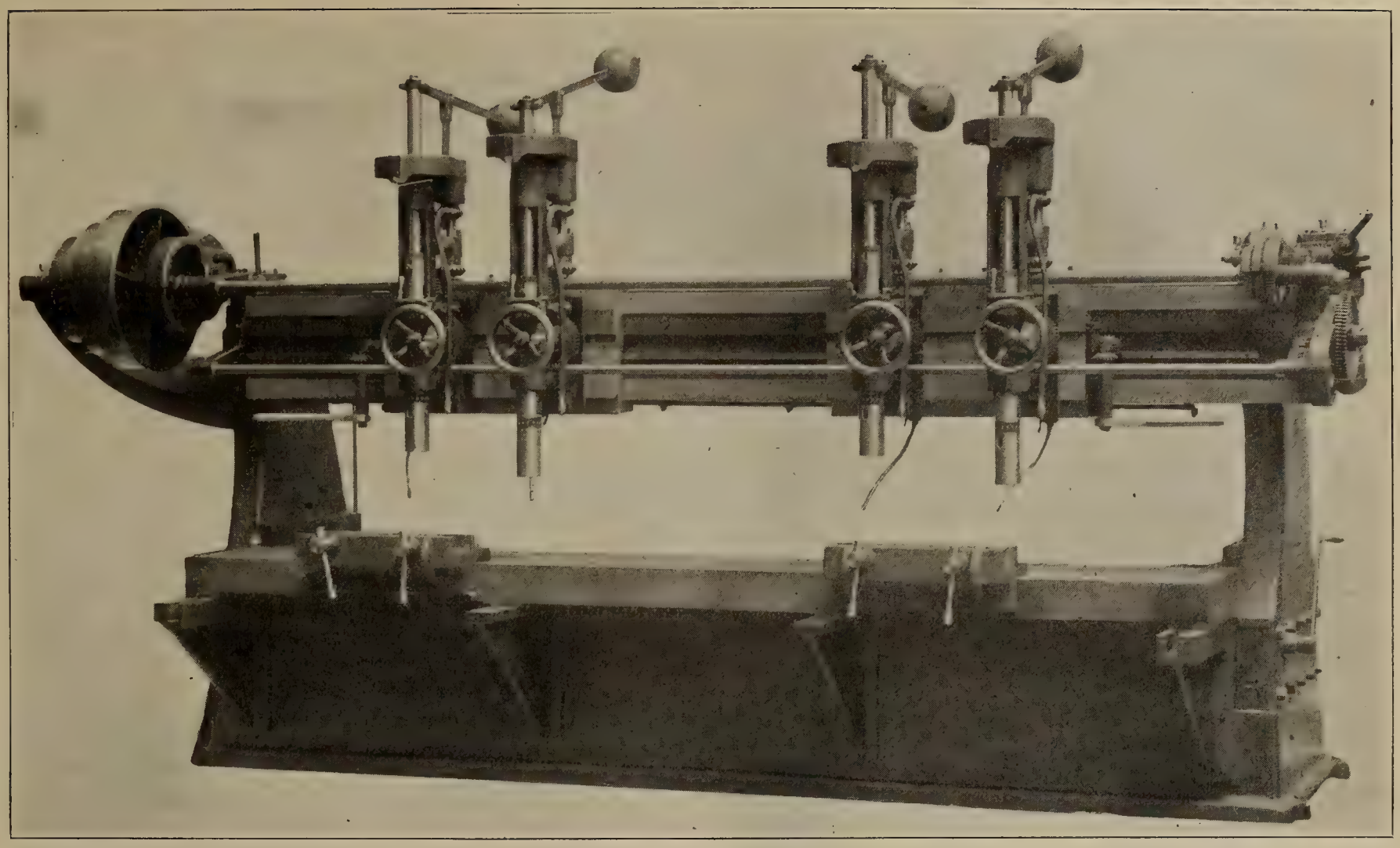
As one set of dies covers the entire range on all sizes of standard pipe where the pitch is the same, it is unnecessary to remove the chasers from their holders, except for grinding purposes. Their removal is accomplished by slackening the two chaser clamping screws on each chaser holder just enough to allow the chasers to be slipped from their seats. They are set to the proper position by bringing the cutting edges flush with the flat surfaces on the chaser slide, provided for that purpose.

A steel scale or straight edge will simplify this operation. Special mention should be made of the mill chaser clamps which overhang the chasers and protect them against split and twisted pipe.

The chasers, which can be used on all sizes of standard pipe where the pitch is the same, are hard their entire length and do not require annealing, hobbing or retempering. They are also interchangeable, that is, any one or more of a set can be replaced without renewing the entire die.

CURTAIN FIXTURE

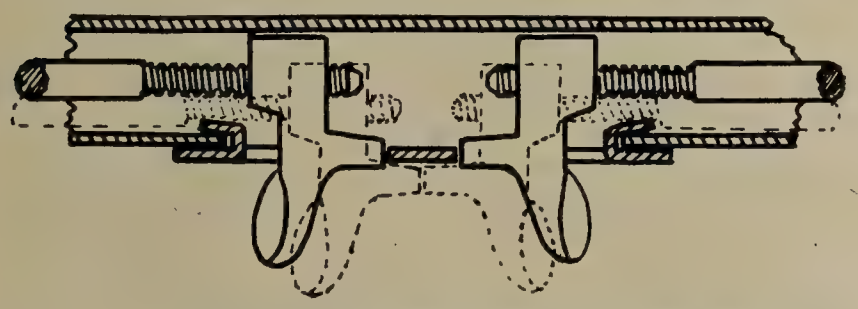
On removing a car curtain from the grooves, the customary way is to push it up at one side until it clears. This necessarily involves stretching the curtain and sometimes results in tearing it. A fixture overcoming this drawback has been brought out by the Railway Supply & Curtain Co. of Chicago. This fixture is shown in the illustration. A pressure on the pinch handles works the fixture in the ordinary manner. A lug on each handle limits the movement by striking against the center web. When it is desired to remove the tips from the grooves the handles are squeezed together and pulled outward allowing



Mud Ring and Flue Sheet Drill.

the lugs mentioned above to pass over the top of the stop so that they come in contact. This allows the curtain to be drawn straight outward. The pinch handles will not get beyond the first movement in ordinary handling.

This fixture also has a "fool proof" adjustment in the



Showing the Two Positions of the Curtain Handles.

shape of a sliding connection between the operating rod and the tips. When the curtain is removed from the grooves a spring holds the rod and tip out of connection so that the adjustment cannot be tampered with. To change the adjustment the tip is pressed in and turned in either direction. When the pressure is released the tip is out of connection with the rod and can be turned freely without altering the length. This fixture is called the "Sta-rite" and it is said that it does not require any attention once it is applied.

Improved Curtain Fixture.

MUD RING AND FLUE SHEET DRILL.

The four spindle machine shown herewith has been brought out by the Foote-Burt Company, Cleveland, Ohio. This machine is for use in railroad locomotive boiler shops and general boiler shops for drilling the rivet holes around a mud ring and for cutting out the flue holes in a flue sheet.

The spindles are the independent feed type, each one being arranged with automatic knockoff to power feed and the quick return of same is taken care of by the use of hand wheel located on the front of the head. Each spindle is also arranged with a clutch for stopping and starting, and an interlocking mechanism so that the feed cannot be thrown in with the spindle stopped, or vice versa. With this independent feed feature some of the spindles are always drilling while the operator is setting the other spindles, so that the full efficiency of both the machine and the operator is obtainable, no time being lost as on the gang feed type.

The spindles of this machine are arranged in pairs which are mounted on auxiliary crossrails and the spindles are adjustable on these crossrails to a minimum center distance of eight inches. The advantage of this feature is that it is possible to set the spindles to the proper spacing of the rivet or flue holes and then adjust two spindles along the main rail of the machine, maintaining the proper spacing and eliminating the necessity of spacing each one individually.

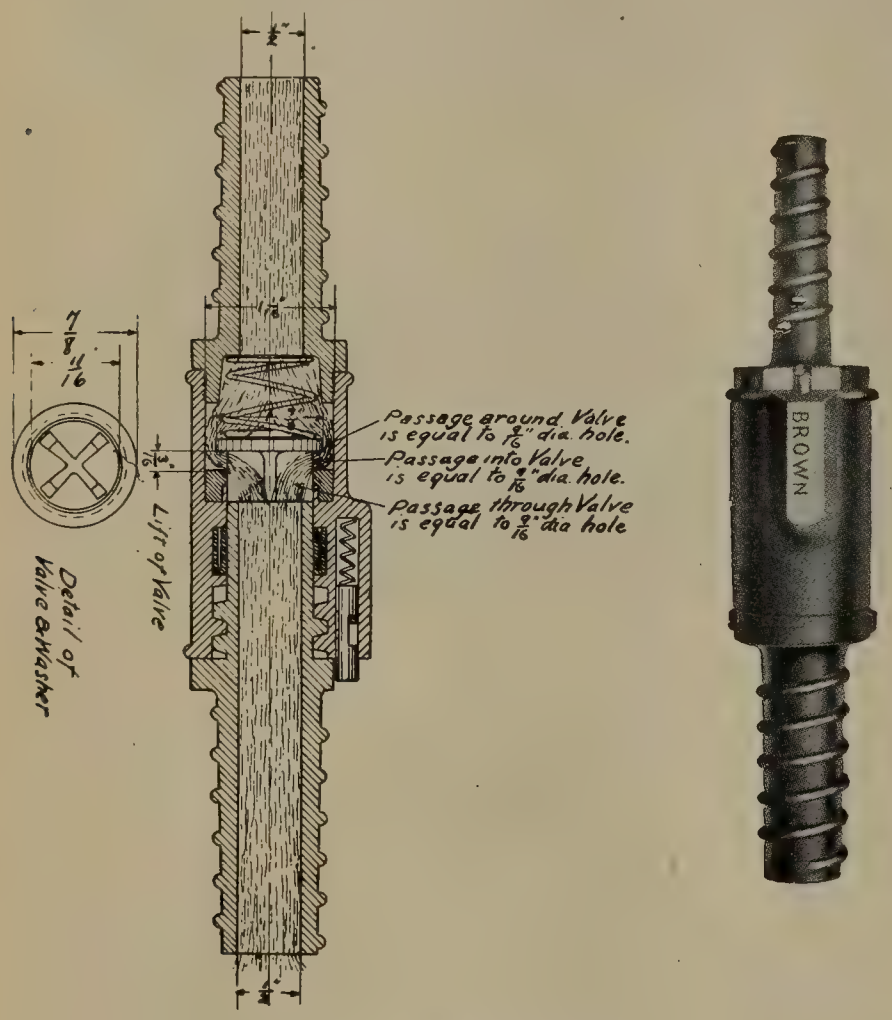
The spindles overhang the front edge of the base eight inches to take care of the mud ring work and the table is provided with chucks for holding the mud rings. The table has an in-and-out motion of thirty-six inches and is supported out under the spindles by the bracket slides on the front of the base.

Three changes of power feed are provided, any one of which is instantly available by simply shifting a lever at the right

hand end of the machine. Six changes of speed are provided by three step cone and throwout back gears. The machine weighs approximately 21,000 pounds.

AUTOMATIC AIR HOSE COUPLING.

An air hose coupling which has several distinctive safety features has been placed on the market by the Brown Automatic Hose Coupler Co., of Toledo, Ohio. In the operation of the coupling one turn of the device serves both to lock the action and open the valve admitting air to the pipe line. The action cannot be broken until desired by the trainmen.


Passage around Valve is equal to 7/16" dia. hole.
Passage into Valve is equal to 9/16" dia. hole.
Passage through Valve is equal to 9/16" dia hole
Lift of Valve
Detail of Valve & Washer
BROWN

Two Views of the Brown Automatic Coupling.

When the cars are uncoupled a valve closes the air line, making it unnecessary to have intermediate valves at the taps, as has been the practice heretofore. This feature results in considerable saving of time and labor.

This company also manufactures different styles and type of direct air or open port couplings, which are considered preferable when working in a temperature so low as to cause freezing of the check valve in the automatic type.

New Literature

The Goodman wrecking hook is the subject of circular No. 63 recently issued by the National Malleable Castings Co., Cleveland, O. This is a hook which can be attached to wrecking cables and fits any M. C. B. coupler.

* * *

The Independent Pneumatic Tool Co., Chicago, Ill., has issued an announcement of Thor electric drills, one of the principal features of which is the fact that they are equipped with a universal motor, so that the machine may be attached to the ordinary lamp socket.

* * *

The Mesta Machine Co., Pittsburgh, Pa., build gas engines for any class of service, and in sizes from 350 B. H. P. upwards. These engines are described in a recent booklet issued by the firm.

The National Tube Co., Pittsburgh, Pa., has issued a folder on the Kewanee air pump union, which is largely used on the air lines of locomotives.

* * *

The Westinghouse Air Brake Co., Pittsburgh, Pa., has issued two of its standard size leaflets, dealing respectively with conductor valves, and air compressor oil cups and sight feed lubricator fittings.

* * *

The Ingersoll-Rand Co., New York, has just issued an eight-page bulletin, form 8011, showing a new line of "Little David" riveting hammers, sizes 50, 60 and 80, suitable for structural work, tank, steel and any other similar work up to 1¼ inches diameter rivets. Booklet is illustrated to show the hammer at work.

* * *

The American Lock Nut Co., Chicago, Ill., has recently issued an attractive catalogue of the "Absolute" lock-nut. The principle of this nut is a rolling wedge consisting of a locking pin.

* * *

The Federal Graphite Mills, Cleveland, O., has issued a booklet containing considerable valuable data on boiler operation, which it is sending out to engineers desiring it.

* * *

The American Mason Safety Tread Co., Boston, Mass., has published a booklet descriptive of Mason safety treads, giving many illustrations of this well-known protection against slipping.

* * *

The Cincinnati Milling Machine Co., Cincinnati, O., has just issued a new catalogue of Cincinnati milling machines. It is a fine example of the printer's art and in keeping with the products which it sets forth. The form has been changed from 6" by 9" to 8½" by 11", which is the standard size recommended by the committee of the A. S. M. E. as embodied in its preliminary report last spring. This enables the use of larger and clearer illustrations. The arrangement of the matter in this catalogue has been changed, and some matter added in the form of illustrations and data showing the various types of machines in operation, all of which aims to give the customer a better idea as to the class of work for which each type and style of machine is adapted. In the rear part of the book mention is made of cutter grinders and a new line of semi-automatic manufacturing machines.

Industrial Notes

The American Steel Foundries is now occupying its new offices in the McCormick building, 332 South Michigan avenue, Chicago, Ill.

Chester H. Jones has been placed in charge of the steam railroad department of the General Electric Co. office at St. Louis.

Blake C. Howard, Mudge & Co., has opened offices in the Railway Exchange building, St. Louis, Mo., to handle a general line of railway supplies. He was formerly southwestern sales manager of Mudge & Co., and will continue to represent them, together with other accounts.

E. E. Hudson has been elected fourth vice-president of Thomas A. Edison, Inc., with headquarters at Orange, N. J. Mr. Hudson continues as heretofore in charge of the primary department.

C. C. Whittier, manager of the Winnipeg, Man., office of the Robert W. Hunt Co., Ltd., Chicago, Ill., has been made treasurer and general manager of that company, with office at Montreal, Que.

G. Fred Collins, who for years has been well and favorably known in the Railway Supply business, has become asosciated with The Protectus Paint Co., in their selling department. His

present address is North American Bldg., Philadelphia, Pa. It is expected that he will later on take charge of a branch office to be opened in Pittsburgh, Pa.

B. T. Lewis, western manager of the Railway Appliances Company, Chicago, died on October 11.

The National-Standard Co., Niles, Mich., is the corporate name of the recent consolidation of Cook's Standard Tool Co., of Kalamazoo, Mich., and the National Cable & Manufacturing Co., of Niles.

Plans have been prepared for a new plant for the Franklin Rolling Mill Co., Franklin, Pa., works of which were partially destroyed by fire last May. The company belongs to the Chicago Railway Equipment Co.

Nicholas F. Brady has been elected a director of the New York Air Brake Co., to succeed his father, the late Anthony N. Brady.

The Southern Wheel Co., recently formed to take over a number of car wheel manufacturing companies, has taken quarters in the Railway Exchange building, St. Louis, Mo.

Judge Carpenter at Chicago has ordered the Central Trust Co., receiver, to solicit bids for the sale of the property of the insolvent Union Car & Equipment Co., West Pullman, Ill.

F. B. Cooley has severed his connection with the Buffalo Car Wheel Foundry Co., and has been made president of the New York Car Wheel Company.

The Chicago-Cleveland Car Roofing Company has let building contracts for an addition to its Cleveland works and the work is now under way.

The Kelly Reamer Co., Cleveland, O., on October 20, increased its common stock from $25,000 to $50,000, to add facilities for its rapidly growing business which has doubled during the past three months. Practically all of the new issue will be taken by the present stockholders.

The McClintic-Marshall Construction Co., has changed its name to the McClintic-Marshall Company.

The Southwestern Steel Development Company at Houston, Tex., has announced its intention of establishing a large steel plant, rolling mills and coking plant at Texas City, Tex., involving an expenditure of about $10,000,000.

The Transue & Williams Company, Alliance, Ohio, has purchased all of the assets of the Davies-Bach Manufacturing Company, including the plant recently erected in Alliance for making steel stampings.

The officers of the American Locomotive Company were re-elected at the annual stockholders' meeting of the company, which was held on October 21, and at which the board of directors was re-elected. Isaac M. Cate, a stockholder at Baltimore, had made certain charges earlier in the year which had been referred to a committee of the board of directors for investigation. President Marshall made an address in which he replied to Mr. Cate's criticisms.

D'Arcy W. Roper, formerly secretary and general manager of the Great Lakes Construction Co., Buffalo, has been made sales manager for the Buffalo Car Wheel Foundry Co., with offices at 84 Dun building, Buffalo.

President Willard of the Baltimore & Ohio in an address before the Merchants' Association of New York, on October 29, very strongly urged freight rate advance for the railways, as that development was held up by lack of funds. In conclusion he stated: "At the present time railroad development and extension, particularly in the eastern territory, is practically at a standstill, and personally I am quite unable to see how it can be otherwise until something happens to increase the net earnings of these carriers.

"I do not believe we can expect to accomplish the relief necessary by reducing wages, or by reducing materially the number of men employed, or by economies generally. Something, of course, may be accomplished in that direction. I do not believe that the relief required will be gained through increased business, because many of the roads are already handling as much, if not more, business than can be done economically with the present facilities, and before any greatly increased volume can be handled, large expenditures must be made for additional facilities.

Ashmead Gray Rodgers, for twelve years superintendent of the Carborundum Co.'s plant at Niagara Falls, died October 23, 1913, as the result of injuries sustained through an accident October 5. Mr. Rodgers had a host of friends and acquaintances throughout the mechanical and chemical world and they will sincerely feel the loss of a man who was so pleasing in personality, democratic in his attitude to others and so capable in his chosen line of work. Mr. Rodgers was a native of Albany, N. Y., having been born there in 1872. Previous to his coming to the Carborundum Co. as superintendent he was superintendent of the Eddy Electrical Co. at Hartford, Conn. His funeral services were held Saturday, October 25, from St. Peter's church at Niagara Falls and were attended by several hundred of the employees of the Carborundum Co., members of the Niagara Club and other friends. Mr. Rodgers was a member of the American Chemical Society, Engineers' Society of New York, Chemists' Club, Niagara Club, University Club and Country Club of Niagara Falls and several other scientific and social organizations.

H. E. Passmore, who has been made a vice-president of the Grip Nut Co., was born at York, Pa., November, 1869, educated at York Collegiate Institute, and the Maryland Institute, at Baltimore, Md. He served his machinist's apprenticeship with the Pennsylvania Railroad at Altoona, Pa., and worked as a machinist on the Norfolk & Western, Baldwin Locomotive Works, Philadelphia & Reading and the Western Maryland. In 1903 he entered service with the Toledo & Ohio Central as a machinist. He advanced through the ranks to the position of master mechanic, which position he has filled with due credit to himself and satisfaction to his company, and from which position he resigned on November 1 to enter the supply field as vice-president of sales of the eastern district for the Grip Nut Company. Mr. Passmore has been an active member in the Master Mechanics' and Master Car Builders' Associations, and is now a member of some of the more important committees. The illustration is a very good likeness of Mr. Passmore. He is a big man, with a kindly eye, a firm handshake, and a host of friends to wish him well and welcome him in his new work.

H. E. Passmore.

Recent Railway Mechanical Patents

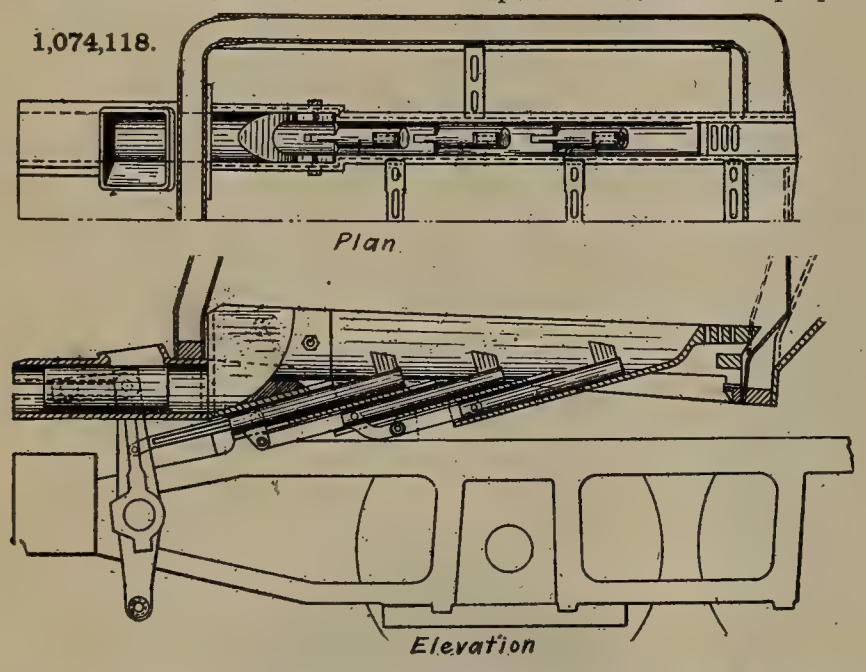
UNDERFEED STOKER.

1,074,118—Wm. C. A. Henry, Columbus, O., assignor to the B. T. U. Co., Pittsburgh, Pa.

The invention relates to underfeed stokers and particularly to the feed trough construction and the feeding means therein. It has for its primary objects the provision of feed means which will agitate the fuel in the trough and secure its upward movement without an undue forward movement; the provision of a trough construction whereby an upward and lateral feed is promoted at the rear end of the furnace and a proper spreading of the fuel to the corners of the firebox secured; and the provision of means of the character last specified which may be readily varied as to position and upword feeding effect, and which may be readily applied to the trough at the point at which its diameter changes to eliminate the pocket which would otherwise be present at this point.

The form of the agitating blocks constitutes one of the features of this invention. Heretofore the top surfaces of blocks of this character have been inclined downwardly and rearwardly instead of downwardly and forwardly as in the present construction. With prior constructions a too great forward feed through the trough was often secured without a sufficient upward feed. It is the purpose

1,074,118.



of the present invention to provide less forward feed and more upward feed. This has been accomplished by inclining the tops of the agitators downwardly and forwardly, so that the top surfaces of these blocks have substantially no forward feeding effect, but have a component of feeding effect upwardly, and the agitators cut through the fuel and prevent packing, and at the same time cause an upward movement of the fuel to the top of the trough.

The second feature of this invention resides in the provision of what may be termed the filler block. The front edge of this filler block abuts against the rear end of the trough, and the interior surface of the filler block corresponds in contour and size with that of the interior of the portion of the trough, so that the interior surface of the filler block constitutes substantially a continuation of the interior surface of the portion of the trough. The rear side edges of the filler block and the rear bottom edge are inclined downwardly and rearwardly, and the block is secured removably in position by means of the studs. This filler block performs several functions. In the first place it provides a gradual inclined transition from the large portion of the trough to the small portion thereof, so that the corner or pocket which would otherwise be formed is eliminated and the coal is permitted to feed forwardly from the one portion of the trough to the other, without any substantial resistance. In the second place the inclined surfaces form a means whereby the coal is given an upward feed through this portion of the trough. This upward feed is desirable inasmuch as there is a tendency in this sort of apparatus for the coal to feed forwardly through the trough and spread out in the forward portions of the furnace, leaving the rear portion of the furnace either partially or wholly uncovered. The upward feed at the rear end of the furnace as occasioned by the filler block causes the coal to work upwardly and then laterally into the corners of the firebox. Filler blocks of varying sizes can be inserted to meet varying needs.

LOCOMOTIVE-TRUCK.

1,074,154—Herman F. Ball, New York, N. Y.

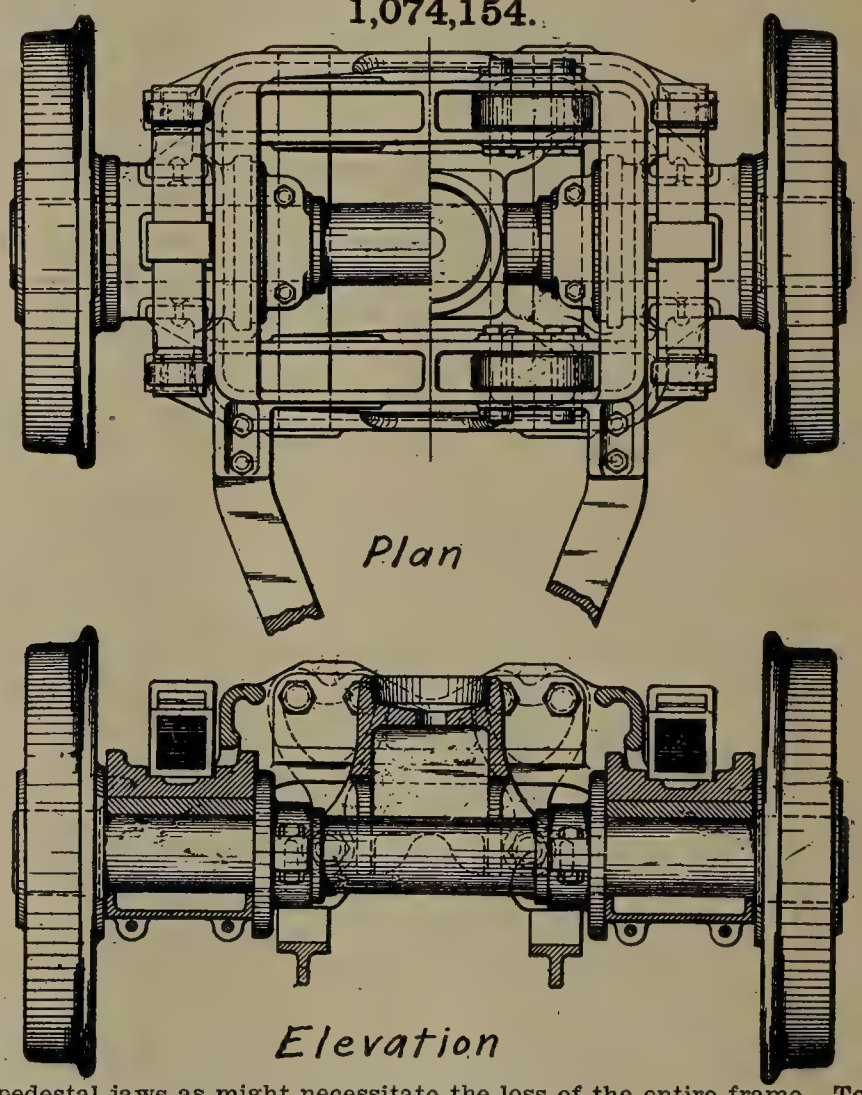
This invention relates to two wheeled leading or trailing trucks for locomotive engines, of the type known as "swing" or "lateral motion" trucks, and its object is to provide a truck of such type, the frame of which shall embody the advantages of strength, simplicity, and economy of construction, and ready accessibility for the insertion and removal of springs, axle boxes, and other accessories, and in which the application of elliptic springs is provided for, in an effective manner and without interference with requisite clearances.

Helical springs have been heretofore ordinarily applied in two wheeled trucks, by reason of the fact that, in many instances, the clearance limitations are such as to prevent the application of elliptic springs, although their use, throughout the locomotive, is, if practicable, very desirable. In two wheel trucks, which construction is that which is used in freight locomotives, almost exclusively, the clearance limitations between the truck frame and engine frame, vertically, and the clearances for the lateral movement of the truck bolster, have prevented the successful application of elliptic springs in trucks of the built up type.

This invention enables elliptic springs to be applied in two wheeled trucks for locomotives of all sizes, and combines the frame members, pedestals, and spring and swing hanger brackets in an integral structure of cast construction. The truck frame is an integral casting, which is substantially of box form, and comprises two parallel front and rear side members, extending transversely of the locomotive, on the outer ends of each of which side members, there are formed pedestal jaws, which project outwardly from the side members, and are set at proper distances apart to receive the axle boxes, and two parallel end members connecting the side members one to the other. The side members are also connected by tie bars, of T section, which are secured to their lower sides by bolts and nuts. The function of the tie bars is analogous to that of the pedestal tie bolts heretofore employed, but instead of being located below the axle boxes, as in ordinary practice, they are connected to the side frame members in planes on the inner sides of, and entirely clear of, the axle boxes. Under this construction, the axle box cellars may be removed and replaced whenever desired, without detaching the tie bars, and a reduction in the depth of the pedestal jaws, and consequent reduction of the weight of the frame, is also effected.

The truck frame being an integral structure, it is very desirable that means should be provided for preventing such wear of the

1,074,154.



pedestal jaws as might necessitate the loss of the entire frame. To this end, the wearing surface of each of the pedestal jaws, against which surface the adjacent side of the axle box abuts, is formed on a detachable shoe, consisting of a metal plate having side flanges which are bent over against the sides of the pedestal jaw, and top and bottom flanges which are similarly bent over against inclined faces on the top and bottom of the jaw.

Federal Judge William L. Day announced at Cleveland on October 28 that the legal tangle which has involved the affairs of the Wheeling & Lake Erie is about to be unravelled. A final hearing of the case of the Central Trust Company of New York, which, as trustee of Eastern stockholders in the road brought foreclosure proceedings five years ago, has been set for December 15. On that date the receivership initiated at the filing of the suit will be terminated. Judge Day today granted the application of receiver Duncan to issue $820,000 in receiver's certificates to fall due July 1, 1914. The action is merely precautionary. The proceeds will be devoted to repairs and reconstruction made necessary by the floods and to purchase of new equipment.

At the annual meeting of the Santa Fe System on October 25 action was taken on the projected double-tracking of a large part of the line between San Diego and Los Angeles, and between Summit, in the San Bernardino Mountains, and Victorville on the desert.

RAILWAY MASTER MECHANIC

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Car Foreman's Association.

The Car Foremen's Association of Chicago recently held its annual meeting and entertainment, at which officers were elected for the coming year, an account of which was published last month. This organization has had a very rapid growth during the past year or two and now has in the neighborhood of 875 members, practically the same membership as the Master Car Builders' Association. The meetings, which are held monthly at the Karpen building, Chicago, are well attended and the papers and discussions as a rule are lively and interesting. With its large membership and its location in the greatest interchange center of the country, this association has an opportunity to exert considerable influence in the car department. Its members are the men who come directly in contact with car repair work and with inspection problems. With the continuance of good attendance and papers of direct interest to the members, the resulting discussions cannot help being of immense value to the railways. It will be remembered that a number of the association's recommendations to the Arbitration Committee last June were adopted. With another set of able officers this year, the association should look forward to a very prosperous winter.

Billerica Shops.

With the opening of the Billerica shops of the Boston & Maine, the important features of which are described on another page of this issue, this road becomes more thoroughly and efficiently equipped for the repair of its equipment than possibly any other railway in the territory. The new repair facilities, as may be noted by reference to the article, are to be used in addition to those which have supplied the needs, more or less thoroughly, of the road heretofore.

It would seem, however, that those charged with the responsibility for efficient operation of the plant will experience difficulty in securing the proper labor to contemplate a thorough shop organization on account of the location of the plant. It is isolated from towns of any size; the village of North Billerica offering about the only possibilities in the way of housing the men. Of course, when an organization of forces is once perfected it will, in the nature of things, be more stable on this account; but variations in the size of the forces cannot but cause difficulty. In the case of necessary retrenchment, which usually takes the form of decrease in the payroll, there will be injustice to the men, and temporary increases will be productive of inefficiency on account of the fact that good men cannot be obtained.

The machine tool equipment is unusually complete and it seems that no expense has been saved in the purchase of the most modern machinery.

Owing to the swampy nature of the ground upon which the shops are located, some difficulty has been experienced in securing proper foundations for the buildings. A drift of boulders across the center of the tract interfered to an embarrassing extent in foundation and other sub-structure work. The steel work is set on concrete piling and it is interesting to note that in constructing the concrete foundations for the steel columns the base bolts were set solid instead of being placed in thimbles to allow for slight errors in the fabrication of the steel. This illustrated unusual confidence on the part of those

responsible, as there could be no variations in dimensions. As was expected, however, the installation was made without difficulty.

Considerable difficulty was experienced with heavy machine foundations, due to carelessness on the part of certain machine tool manufacturers, who sent incomplete or erroneous dimensions for foundation construction. It would seem that machine tool builders should take steps to overcome this difficulty, since it is so unnecessary that these errors appear. Complete and accurate specifications in so far as they relate to foundation construction should be readily available in advance.

The shops will be in operation early in the spring of 1914, unless financial difficulties should arise to prevent. The plant is a credit to the railway, which has, through its own organization, handled more of the details of plans and construction than is customary.

Steel Passenger Cars.

If such of the daily press as are clamoring for steel cars were aware of the dangers incident to the use of all steel equipment on electrified lines (electrification being, by the way, also an object for clamoring) there would be less public agitation on the subject. It may be reasonably expected that there will be many unexpected electrocutions as a result of some future wrecks on electrified lines operated with all steel passenger equipment.

Until proper and adequate methods for completely insulating steel passenger cars are developed there is real danger in the operation of steel equipment over electrically powered lines, while lumber of proper quality is available the best possible passenger carrying vehicle is the steel underframed wooden body car.

Just as wooden construction was the common cause of the cremation of the unfortunate victims of railway accidents when oil lamps and coal stoves were in use, so will the steel car be the cause of the electrocution of the victims of future accidents on electrified lines.

The coal heater and the oil lamp are no more, in main line operation and there is now no great danger of fire in case of accident. The steel underframe gives all of the resistance to telescoping that the all steel car may be expected to give. Why, therefore, should railways accede to the clamor for all steel equipment? The interests of the public are really those of the railways and these interests are not best protected by all steel passenger equipment.

The Drifting Draftsman.

The draftsman is getting to be a wanderer. He drifts about the country almost as much as the bridge builder. He is most always a young man and comparatively seldom an old man, which leads one to ask what becomes of the draftsmen. There will probably be more old draftsmen thirty or forty years from now than there are now. A large number of him, collectively speaking, have been turned out during recent years. Aside from the technical colleges, there are innumerable schools, both day and night, which are turning out draftsmen in large numbers. As a result, the market is flooded and the railways can increase or decrease their drafting forces at will. When work is slack, fifty or sixty are dropped, when there is an excess of work an equal number of entirely new men are put on. In the meanwhile the fifty or sixty who were dropped have traveled to a place where there is plenty of work.

The constant changing of the size and personnel of a working force cannot make for efficiency, although this is less true in the drafting room than in the shop. It is not so easy to increase the number of competent men in a shop on short notice, but the managements can scarcely be blamed for pursuing this policy in the drafting room when they can get all the men they want, having enough ability for the work in hand, on short notice.

Too many draftsmen are being manufactured; the schools are too busy turning out men for white collar jobs and are neglecting giving men an elementary training which will fit them to work understandingly in the shop, where the pay of the expert workman is larger, his position steadier and his chances for advancement greater. If when a railway lets out a large number of draftsmen, and it would make efforts to locate them in the shop, the ones persuaded to make this change would find their work more satisfactory and find themselves further ahead in the long run.

Anyone who can handle a T-square and ruling pen thinks he is a draftsman and the draftsman is getting to be a drifter because the field is overcrowded.

Economy in Castings.

In an article on "Castings and Economy," on another page, B. H. Logan touches on some phases of railway mechanical work which are often lost sight of. It is indeed true that in many drafting rooms the draftsman designs a casting whenever he finds he needs one, with the result that a vast stock of patterns accumulates and of course a number of duplications occur. Mr. Logan suggests that the cure for this state of affairs is system, and as a comprehensive index can hardly be made to which a man can refer for the casting he wants, he suggests that one man be detailed to handle the pattern stock and design all castings. In this day when the railways are put to it to effect all the economies possible, there is indeed something to think about in Mr. Logan's suggestion.

Steel Box Car Construction.

The American Society of Mechanical Engineers has shown considerable interest in railway work recently. During the past year a number of railway sessions have been held and much good has been accomplished thereby. At a session held in New York on December 2 a paper on "Steel Upper Frame Box Cars" was presented by R. W. Burnett, master car builder of the Canadian Pacific, and a paper on "Steel Underframe Box Cars" was presented by George W. Rink, mechanical engineer of the Central of New Jersey. Both papers are reproduced in abstract elsewhere in this issue. They are both comprehensive papers, covering the present state of steel box car construction thoroughly and the American Society of Mechanical Engineers deserves credit for having arranged for presenting them at one of its meetings.

The steel underframe and steel upperframe cars have made good and their use is being extended. Mr. Burnett points out an interesting fact in the influence which the steel upper frame has had upon car roofs. Due to the fact that there is no appreciable movement in the framing, it is not necessary to design the roof to reinforce the superstructure, thus allowing a lighter roof to be

used, which in turn lowers the center of gravity and lessens the cost. The steel upper frame is not entirely rigid and will sustain a slight distortion without injury. However, it would be interesting to know what effect, if any, the steel upper frame box car has on derailments; whether its rigidity in any way affects the travel of the trucks.

Mr. Burnett and Mr. Rink do not seem to be entirely in accord on the question of a standard box car. Mr. Burnett states that "no committee will ever develop a car that will be adopted as standard, but the nearest we will ever get to a standard is what may be developed by one or two persons given a free hand." He holds that the universal use of a steel frame inside sheathed box car would be close enough to a standard car, as nearly everything below the underframe is already standard and that with the use of standard rolled shapes the upper framing could easily be renewed at any point. In many cases the repairs would involve only the labor in straightening the framing to its original shape. For 30,000 cars of this type on the Canadian Pacific, says Mr. Burnett, no material is carried in stock for repairs outside of that common to all cars. He concedes that parts should be standardized if the wooden box car construction be continued.

Mr. Rink states that "the time has now arrived to introduce additional standards affecting the maintenance of box cars which can also be applied to all types of freight cars used in interstate business." Speaking of the steel frame box car he says: "This type of framing * * * lends itself very readily to standard construction and it is well to note that with the exception of intermediate posts and braces, we are again confronted with a variety of sections and weights of materials comprising the side plate, side sill, corner and door posts." In support of this, Mr. Rink compiled considerable data showing the diversity in sections and weights used.

The steel upper frame car, it is true, does adapt itself readily to standard construction, but nevertheless it is in its infancy and a few years will see a diversity in the designs put out by the various roads. It will then become a much harder matter to standardize it. If a standard steel upperframe car is to be brought out, it should be done now, as the number of steel frame cars in use is increasing rapidly. The cars being built at present are in general similar, although the Pennsylvania already has built a number of steel upperframe cars which have a framing which is different in many respects. A number of radically different designs such as this would make the question of the repair of steel upperframe cars as bad as that of wooden cars. The inside sheathed steel upperframe box car, as used on the Canadian Pacific and other roads, has shown itself to be very satisfactory, and as the steel frame car is the car of the future it would seem that this is the time to adopt standards for such a car.

MECHANICAL CONVENTIONS.

At a meeting held at the Vanderbilt hotel, New York on November 4, it was decided to hold the mechanical conventions for 1914 at Atlantic City, N. J. The Master Car Builders convention will be held on June 10, 11 and 12 and that of the American Railway Master Mechanics Association on June 15, 16 and 17. Rolling chairs will be provided as at the last convention and the same number of informal dances will be held.

Twenty Years Ago This Month

(From the Files.)

The Manchester ship canal was opened December 7. It is 35½ miles long and cost $7,500,000, or about $2,100,000 per mile.

Thos. Freeman, formerly of the National Tube Works has been appointed a representative of the Detroit Lubrication Co., with offices in the Western Union Building, Chicago.

The "Columbia," the famous high speed locomotive of the Baldwin Locomotive Works, built for exhibition at the World's Fair, has gone into freight service on the Chicago, Milwaukee & St. Paul for the purpose of "breaking in." It will haul fast passenger trains between Chicago and Milwaukee.

The list of insolvent railways was increased with startling effect on December 23 by the announcement that receivers had been appointed for the Atchison, Topeka & Santa Fe.

A. L. Mohler has resigned as general manager of the Great Northern on account of the poor condition of his health.

E. C. Clark has been succeeded by George A. Post as president of the Standard Car Coupling Co.

G. W. Cushing has been appointed general master mechanic of the Cincinnati Southern.

The Lima Locomotive & Machine Company, Lima, Ohio, which purchased the plant of the Lima Steel Castings Company, has opened for business.

Robert Quayle has succeeded William Smith as superintendent of motive power and machinery of the Chicago & Northwestern. Mr. Quayle has been division master mechanic of this road at Kaukauna, Wis.

Riter & Conley, of Pittsburgh, have been awarded the contract for rebuilding the Bettendorf Metal Wheel Works, Davenport, Iowa. An all steel building, 70x340 feet will be erected.

John Horrigan has succeeded J. F. Sechler as master mechanic of the Elgin, Joliet & Eastern.

Henry Bartlett has resigned the position of assistant superintendent of motive power of the Pennsylvania to become superintendent of motive power of the Boston & Maine.

Officers of the Trans-Siberian railway are in the United States for the purpose of deciding whether or not to use American-built locomotives on their line.

The Union Pacific shops at Cheyenne are to be closed permanently on December 31.

Old "999," the engine that was once the pride of the New York Central and held the world record for speed, has not reached the scrap heap yet. After being relegated to the hauling of a milk train, because it could no longer compete with the more modern locomotive, "999" had its number changed to 1086. Once the wonder of the world and exhibited at the World's Fair in Chicago in 1893, the old locomotive had runs between Syracuse and Cape Vincent, at 30 miles an hour. It still holds a firm place in the hearts of all old railroad men.

DERAILMENTS.

There are two fundamental causes for the derailment of cars: where the wheel is lifted off the rail and where the flange climbs the rail.

Owing to the demand for greater carrying capacity and, in many cases, being confined to a given length of car to meet the loading facilities, especially hopper cars, the designers have been obliged to increase the height of the car sides until they have about reached, and in some cases passed, the point of safety. Evidence of this is seen in the numerous derailments, particularly in the case of new equipment.

As these derailments occur on straight track as well as on curves, the cause can usually be located in excessive side bearing spread and clearance which allows the car body to roll from side to side until the lateral thrust, due to the excessive height of the load, is sufficient to raise the wheel off the rail.

In other cases where the derailment occurs on a curve we

find the same condition as in the former case, only aggravated by other causes.

Owing to the elevation of the outer rail, the center of gravity is carried towards the inside of the curve, with the result that much less power is required to raise the wheels off the rail than in the former case.

As the outside rail on main line curves is elevated to counterbalance the centrifugal force of high speed trains, it stands to reason that a freight car, moving at a much less rate of speed, will naturally roll towards the inside of the curve. Now as the side bearings are usually located considerably outside of a line connecting the center of gravity and the rail, the tendency of the overhanging load, especially when dropped three-quarters of an inch or more, is to release the load from the outside wheels or lift them off the rail.

In our present design of steel cars, the underframe is almost rigid and as a result there are many times when the load is almost lifted off one of the center plates. This is the case when a car first enters a curve. As the leading wheels raise up on the elevated rail the load is transferred to the outside side bearing on the front end of the car, in some cases to the extent of raising the load off of the center plate. In one case under investigation a car equipped with cast steel bolsters, truck and body, the center and side bearings being cast on the bolsters, was used.

When this car was just entering the curve the outside side bearings on the leading truck came in contact and as the car was moved forward the weight on these bearings increased until the entire load on this end of the car was resting on one side bearing, the center plates not being in contact; as a result the flange of the leading wheel climbed the rail and the car was derailed. This test was made to demonstrate the cause of a derailment that occurred at this point to the same car.

It is needless to say that this car had a steel underframe and the side bearings were rough cast iron with a clearance of only about one-eighth inch. The side bearings were then given three-eighths inch clearance and the car operated freely over the same curve. The center of gravity on this car was low, but had it been as high as in some of the new hopper cars the increased excessive clearance of the side bearings would have made the car unsafe to run.

Another similar case occurred to a tank car having the body bolster or saddle riveted to the tank. Several of these cars were derailed on curves and a test was made to discover the cause of the derailments and the same condition was discovered as in the former case. A number of these cars were then equipped with roller side bearings and no further trouble was experienced, a practical demonstration that reducing the friction between the truck and body is a positive remedy for this class of derailments, even if there is only a slight clearance between the side bearings or none whatever.

Owing to the greatly increased weight and capacity of both freight and passenger equipment, it has become a positive necessity to reduce the friction between the truck and body, to insure safety in operation, and that can only be done by the application of a frictionless center or side bearing, or both, and the fact that several hundred thousand cars have been equipped with them in the past few years shows that the railroad managements are coming to the same conclusion.

The passenger equipment, fortunately, is less liable to derailments, owing to the greater length and weight of the car body and trucks, and a much lower center of gravity, but undoubtedly some cases of derailment could be traced to one or the other of these causes.

The reduction of friction between truck and body not only lessens the danger of derailment, but reduces rail and wheel wear and a corresponding reduction in the power required to operate the train, all of which has been thoroughly demonstrated in the past few years.

MASTER CAR BUILDER.

THE RAILROADS' RATE APPEAL.

The opening statement for the railroads in their application for freight rate advance cannot but make a strong impression upon public opinion. It unquestionably is worthy of unprejudiced and thorough consideration not merely by the commission but by the press and the public, in order that the decision reached finally by that tribunal may be understood and accepted if it should approve higher rates.

There is little doubt that the issue now raised before the commission is one of exceptional gravity. If conditions are what these railroad managers declare them to be, a denial of relief by the commission will precipitate so serious a crisis as to involve not merely the railroads but the commercial and financial prosperity of the nation.

But even if this be an unduly dark view of the situation, the issue remains serious enough. The figures present a condition which makes railroad growth impossible and the arrest of railroad development means nothing less disastrous than the arrest of national development. As it is, the business of the country is growing and requires steadily increasing traffic facilities. These must be paid for, and the capital will not be forthcoming unless it is assured its return. There is not a little truth in the complaint of railroad managers that since the adoption of regulation the whole tendency has been to exact from the railroads, and however desirable most of these exactions were from the standpoint of the traveler, the shipper, and the employe, they involved considerable expenditures.

"The railway system of the United States," as one of the most progressive of the railroad men points out, "which constitutes in the aggregate over 40 per cent of the entire railway mileage of the world, has been built up almost wholly with private capital, and those who have invested in railway securities have been encouraged to do so by the belief that money so invested would bring fair and reasonable returns at least, and they have been assured again and again, by commissions as well as by the highest court, that they were entitled to returns of that character. It has finally come about, however, that money invested in railway properties does not yield the same measure of return as is to be gained from money invested in other undertakings, and of course there can be only one outcome from such a state of affairs—that is to say, we cannot continue to look to private capital and private enterprise for the further necessary development of our transportation system unless the returns to be gained in that direction are sufficiently inviting to make the necessary capital forthcoming. Private capital cannot be forced to invest in railways."

The alternative is public ownership, and the American people are not so impressed with their political efficiency and purity as to be ready to enter upon such a project. We have just set up the system of regulation, and it is our business to perfect that system. But the essence of such a system is justice to all—to the public, the shipper, the employe, the investor. In the largest sense the interests of all these converge upon the efficiency of the railroad. Efficiency depends upon ample facilities; facilities depend upon ample capital; capital supply depends upon fair returns.

As the Tribune recently has said, what is needed is a constructive policy, fair to the consumer, who "pays the freight"; to the shipper, whose prosperity depends upon efficient service and no favoritism; to the bona fide investor, and to his partner in the enterprise, the employe.

The fight for railroad regulation, in which the Tribune is glad to have had a part, has been won. But being won, it will be lost if regulation is merely negative or punitive and does not take into account the basic need of the country for an efficient, expanding traffic system and the fundamental terms upon which such a system can be maintained under a capitalistic organization of society.—The Chicago Tribune.

Steel Box Car Construction*

STEEL UPPERFRAME BOX CARS.

By R. W. Burnett, G. M. C. B., Canadian Pacific Ry.

This paper which is confined solely to superstructure details of the steel frame box car is intended to apply in general to steel frame practice as developed in connection therewith. While the early development of steel upper framing is passed over rather briefly, many of the important considerations that have influenced its adoption are discussed in detail, particularly as viewed by the Canadian Pacific Railway. The information and data presented are based on the writer's experience on this railway system in connection with the design, construction and maintenance of 30,000 cars of this type, which represent an investment of $30,000,000.

Credit is due to C. A. Seley, formerly mechanical engineer of the Rock Island Lines, for designing the first outside sheathed steel superstructure box cars that were constructed in large numbers. The introduction of steel into the superstructure of the box car, and the development of the outside sheathed steel superstructure in particular, were discussed so thoroughly by Mr. Seley in his comprehensive paper before the Franklin Institute in January, 1910, that I have thought it unnecessary to go over this same ground, but will review only briefly the development of the box car from the all-wood car through the intermediate stages of steel underframe cars.

The original wooden car, with the single spring draft rigging having the check castings bolted to the sill, gave little if any more trouble than modern equipment, due principally to the shorter trains, lesser density of traffic and to the use of link and pin couplers which compelled gentler handling of trains than is prevalent today. The steel underframe car was built mainly to secure a stronger center construction for the attachment of draft rigging and to get away from the trouble caused by wooden sills breaking and splitting, broken draft bolts, etc.

While having many advantages over the old wooden car, the steel underframe car developed some troubles peculiar to itself, the most important being due to the fact that the body being carried on a rigid frame and not held together by the strains resulting from its weight, as in the old trussed cars, has a tendency to develop slack in the superstructure. This in turn affects the roof and sheathing. One principal trouble with outside sheathed cars is that, after they have been in service a comparatively short time, the sheathing frequently loosens at the end sill and at the side sills near the bolsters with resultant leakage of grain.

There were some steel frame box cars built previous to 1909, but the writer has been able to secure data on only the outside sheated types. Of these 2,700 were in service on the Norfolk & Western, of which the first 100 were built in 1902; the owners advise they were satisfactory and the same type has been purchased on subsequent orders. The Rock Island and Frisco lines had in service at that date approximately 5,000 cars similar to the Norfolk & Western, and these also appear to have given satisfaction as the owners have reordered the same type several times. All of these, however, were outside sheathed and as regards leakage at the sills, had comparatively little advantage over the wooden cars. Recently both of these lines have purchased some inside sheathed cars.

In 1908 the Canadian Pacific Railway designed a steel frame inside sheathed box car. This car avoided the disadvantage of the outside sheathed car which had not been accomplished by the steel frame cars constructed up to that time, and at once obtained a further reduction in weight and provided for cheapness of maintenance by the use of steel superstructure, without the additional lumber required by the outside sheathed car. With practically no preliminary experimenting 500 of these cars were built and since over 30,000 have been built similar to the first cars, with the exception of several refinements of details, such as corner and door posts, end doors and side plates, and joining of flooring and lining. These changes have not affected the general design of the car, but are the improvement that have been introduced from time to time to reduce weight and simplify the construction.

The steel frame outside sheathed car has several advantages over the types previously used, notably in that the tare ton weight is low in proportion to the capacity. There is such a variation in the figures used for the cost of hauling per ton-mile, that no attempt is made to say what the saving would amount to, but certainly the advantage of having a car equal, if not superior to other cars in all respects, weighing from 1,000 to 5,000 lb. less will appeal to all traffic and operating men. Not only is there that much less dead weight to haul when the car is empty or partly loaded but additional lading can frequently be carried. The actual limit on the paying load that can be carried in a properly designed car is the total weight on the axles. Thus, a car having 5 in. by 9 in. axles with such a tare weight that, when deducted from the capacity of the axles, allows the car to be safely loaded to 88,000 lb. could, if dead weight be reduced by 3,000 lb., safely carry a paying load of 91,000 lb. and retain the same strength. Thus the actual capacity of the car is increased almost 4 per cent with a better ratio of paying to dead load.

With the wooden superstructure, it had been thought necessary to assist the superstructure by heavy roof construction, some going so far as to use different methods of diagonal bracing, but with the steel car it has been found that there is no appreciable local movement of the framing in the heaviest service which makes a simple proposition of the roof as it has only to take care of itself. This presents a simpler problem to roof designers, making it possible to design a roof much lighter, without necessity for use of purlins or ridge poles to strengthen the car. It is obvious that unnecessary weight in the roof raises the center of gravity, and increases the tare weight and cost and has other disadvantages.

In explanation of the local movement of this style of framing, it is well to mention tests we have made in jacking up this car, which demonstrated that the car would take a gentle twist from end to end, allowing the bolsters to be slightly out of the same plane horizontally. This twisting was accomplished without any perceptible local distortion of the sides or ends. The capacity for twisting is a condition to be desired as it allows a car to adjust itself to uneven track conditions.

In addition to being 5½ in. narrower than the outside of the sheathing of a wooden car, the superstructure of the Canadian Pacific Railway car is protected by the framing, so that a side swipe that would do serious damage to an outside sheathed car frequently does not touch the lining and is resisted by the framing without damage to the posts or braces. Frequently it is found that a side swipe that would almost demolish the sides of a wooden car only bends the steel framing, and in making repairs, the lining is merely removed, posts and braces straightened and the original lining replaced, the whole cost being the comparatively small labor charge. Jacking frames are being installed at all of our principal repair points for all classes of steel cars, and while not original with the Canadian Pacific Railway, have been amplified better to take care of steel frame box cars. With these frames, many jobs that would require the car to be cut apart, taking several days, can be done in a few hours without cutting rivets. With modern steel frame cars, these jacking frames are as much a necessity as the blacksmith shop or any other part of the shop.

With the outside sheathed car, it is difficult to clean a car properly when it is unloaded, on account of grain lodging between the framework and also on account of the opening where the posts and braces meet at the bottom becoming obstructed, resulting in

* Extracts from two papers presented before The American Society of Mechanical Engineers, December 2, 1913.

grain being retained between the sheathing and lining with resultant complaints from shippers. All of this is overcome by the clean joining of the lining and the floor in the steel frame cars, and it is believed a change of this kind would have come years sooner if designers had kept in close touch with service conditions. One advantage of the steel frame car is that outside of possible repairs due to wreck damage and to wear and tear of couplers, wheels, brake shoes and journal bearings, the car does not deteriorate more rapidly in service than when stored.

The grading of lumber for use in these cars is an item that has received much consideration. Yellow pine or fir has so far been the principal lumber used, although we have experimented to some extent with spruce. Spruce has the advantage of being lighter, but it seems to be more difficult to dry it sufficiently for this purpose. Great pains have been taken to avoid knots that are too large or numerous and while it is generally desirable to have lumber as free from knots as possible, I have never in the inspection of many hundreds of cars, seen where a knot had fallen out. It is, however, desirable to have lumber as free from sap and shakes as possible and thoroughly dry.

When the first of these cars were built outside of the Canadian Pacific Railway shops we had considerable difficulty in getting the lumber properly dried due to lack of both experience and facilities on the part of the car companies. We have about 3,000 cars on which the lumber has shrunk and given them a bad appearance, but this result was expected, as when the cars were built the lumber was quite green. The sheathing on these cars could be tightened for less than $4 per car, but very few have been tightened owing to receipt of practically no reports of loss or damage to lading due to the shrinkage; also as they do not frequently reach our main repair tracks, being shopped only for such repairs as wheels, or wreck damage, we have not considered it advisable to shop the cars for a defect which is almost entirely a matter of appearance. The lining shrinks as much in two months of summer weather, as it ever will.

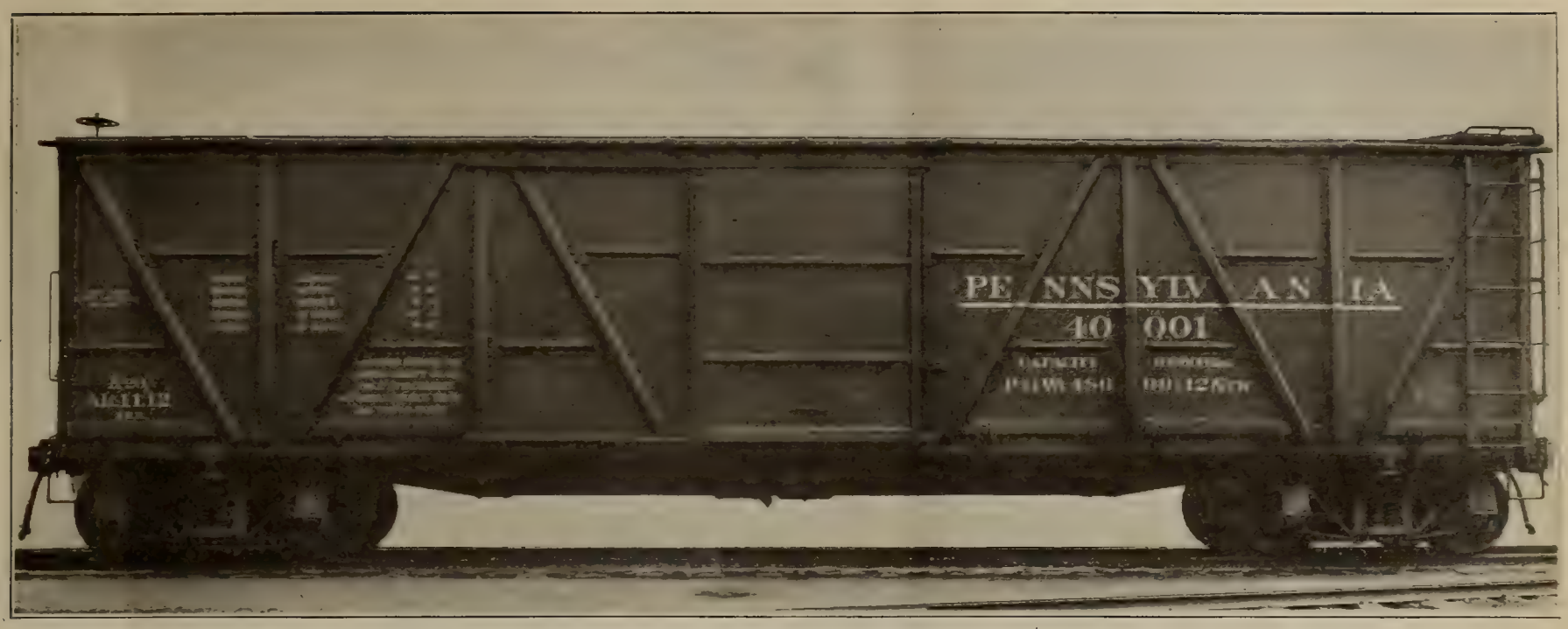
The lining should not be matched before drying, as it warps and curls rendering it difficult to make a tight joint. The rough size of lumber should be at least ¼ in. greater than finished dimensions. In establishing limits for drying lumber no information or data could be secured whatever, and after experimenting we came to the conclusion that a piece of this lining of full cross-section subjected to a temperature averaging 170 deg. fahr. for 96 hours should not lose more than 6 per cent. in weight and that lumber represented by samples losing more than 10 per cent. must not be used until further dried.

The variable condition of the lumber when taken from the yard makes it necessary to use careful judgment as to the length of time it should be kept in the kiln. At the Angus shops of the Canadian Pacific Railway this responsibility falls on the woodmill foreman whose constant attention to this feature makes him the best fitted for the purpose. The average moisture loss reported by the test department for lumber used on cars now building at the Angus shops is 5.25 per cent which shows that we are getting very satisfactory results from the kilns. A number of tests were made last year on lumber taken from the yard. These tests showed a moisture loss of between 25 and 30 per cent. which shows the importance of drying lumber properly.

Due largely to our insistance, nearly all of the car plants in the country are now equipped with dry kilns, and any possible additional cost of drying lumber in excess of what has been considered good practice in the past would be less than $1 per car. Such drying would make the car side practically the same as one board so that it is absurd that the possible shrinkage of lumber should be considered as any reason for this type of car not being built. It has been claimed that lumber can be so dried that it will swell and bulge, but we have never found this to occur. We have had cases where lumber slightly moist has dried more rapidly on the inside, due to that side not being painted. and made the outside of the boards slightly convex, with tight joints that could be easily mistaken for swelling, whereas the opposite is the case. We have kept a car with very green lumber in the passenger shop with a high temperature for over a month until the lumber was absolutely bone dry, and then put it outside with doors open through four weeks of constant raining spring weather, with the result that there was no closing of the cracks that could be detected which further proves that there is nothing to be feared from lumber being too dry.

The defects in the sheathing that must be most closely watched are shakes or splits that extend obliquely downward into the car which must be knifed in with paste before the car is painted. The edges of the lining should be painted, and we have found this can be done more easily and thoroughly by dipping the boards and putting them through between two rubber scrapers which removes the surplus paint leaving the edge thoroughly

Outside Steel Frame Box Car, Wabash R. R.



50 Ton Outside Steel Frame Box Car, Pennsylvania R. R.

coated. This gives a thin coat of paint on the inside of the car which is an advantage in causing the lumber to dry more uniformly and diminishes the tendency to warp. Narrow boards have the advantage of having less tendency to warp, and also if the lumber should not be thoroughly dry, there is less total shrinkage for each board making the space between the edges narrower. The steel work and roofing are painted the same as other cars. This considerable space has been given to the grading and drying, and painting of lumber, as we have found that these factors have required much more attention than everything else combined in connection with the car.

The development of the inside sheathed car has been so rapid and the experience with it so uniformly satisfactory, that I feel safe in saying that its introduction in such large numbers on so many roads in so short a time indicates more nearly a tendency toward the adoption of a standard car than has any distinct type of car outside of patented cars for special service. It is certain that there will be no backward movement to a wooden superstructure, and that this car with possible modifications will remain a standard car unless some superior type of car is developed. It may be stated as the writer's opinion that no committee will ever develop a car that will be adopted as standard but that the nearest we will ever get to a standard is what may be developed by one or two persons given a free hand, and the merit of which, is so pronounced that it forces itself upon the country.

With the use of structural steel there is less necessity of carrying special parts in stock on account of repairs being largely a question of labor, and it seems that with this type of car the necessity from a repair standpoint for a standard car is decreasing. This is further borne out by the fact that for the 30,000 cars of this type we have ordered no material for repairs and carry none in stock outside of material common to all cars, except lining; of the lining, our stock amounts to practically nothing. We save out sufficient of the parts from cars destroyed to make up our stock of repair parts, but have found it necessary to use very little of this. There are, of course, many valid reasons why cars should be made to standard inside dimensions and outside clearances.

To look at the matter in another way, the wheels, axles, journal bearings, journal boxes, couplers, brakes, safety appliances, etc., which constitute the removable and perishable parts, are all standard and when it is remembered that nearly all of the remaining parts of the cars are standard rolled shapes which are easily obtained either from the mill or from stock in all principal cities, it is apparent that we now have in effect, a standard car, or at least a car of standard parts. A car of different dimensions would not increase the cost of maintenance as long as standard shapes are used; nor would it if every lot of cars is designed differently, as long as proper strength is maintained, and any change in design would usually be to increase the strength. In other words, to keep a car as close as possible to standard and reduce cost of maintenance, rolled shapes should be used in preference to pressed shapes where possible.

It is my belief that the people who are urging the adoption of a standard car for maintenance reasons have in mind the remaining wooden cars for the maintenance of which large quantities of timbers and castings have to be kept in stock. It is of vital importance that the parts be standardized if that style of construction were to be continued. It should not be overlooked that in a car constructed with rolled shapes, these parts seldom need renewal even when the car is wrecked, as they can easily be straightened or formed to the original shape at any car repair point, while wood would have to be replaced and pressed shapes would call for special dies to reform them. With a wooden box car the amount of material neecssary to carry in stock and use for repairs increases rapidly with the age of the car. With a steel frame box car the amount of material necessary to carry in stock and use for repairs outside of parts common to all cars does not increase with the life of the car.

The wind resistance on the steel frame box cars with inside sheathing is slightly greater than on a smooth outside sheathed car, but on the other hand, it is less than on any ordinary type of stock car. The effect of wind resistance between box and stock cars, has never been great enough to require any distinction between them as to the number of cars that could be hauled in a train of either and is really a refinement that not even a dynamometer car can detect. A small change in the angle or velocity of the wind, or difference of the number of wheels running to one flange, or trucks somewhat out of square, affects the haulage of the train too much to enable any satisfactory figure for the difference in the wind resistance of the various types of car to be obtained. There is a certain stretch of track on the western plains of about 40 miles without a curve and practically level where high winds are frequent, on which the haulage capacity of locomotives is dependent principally upon the wind, and yet even there it was found practically impossible to distinguish between the wind resistance of stock and box cars. From this, it is evident that the wind resistance of steel frame inside sheated box cars as compared with outside sheathed cars may properly be ignored.

In the summer of 1911, we lined one of these steel frame cars with corrugated steel and found it to be as simple a matter as lining with wood. We lapped and rivetted the sheets, which were No. 13 gauge, between the door and end, and had the corrugations on the side and end coincide, pressing into special corrugated angles in the corners to break the joints. At the floor, we straigtened out about 4 in. of the corrugation and formed of it

an angle that rests on the side sill, and on this the ends of the floor boards were superimposed, easily making as tight a joint as I have ever seen on any car. After 18 months of general service this car was brought in and on examination, found to be in as good shape as when constructed. It was interesting to note that, when inspected, the paint sealing the joints, where the side sheets lapped, was in no place seal broken, indicating that there is no material weaving or deflection of the sides. The paint was in perfect condition, there still being some gloss, indicating that in the use of steel there is no disadvantage as far as the painting is concerned. Different methods of lining with steel could be followed, and I am convinced that if experience proves that there is no damage to be feared from heat, cold or sweating, that steel lining will be largely used. But, I am also convinced that the use of steel lining with any insulation will never be extensively used as it adds to the cost and weight without affording any protection to the lading, which is not secured by the wood lining. An advantage of this construction is shown in Fig. 10, in the application of hoppers under the door openings, which were made without alterations to sills or cross bearers.

As regards the end of the car, we use two 4 in. Z-bar end posts of 8.2 lb. per ft., with 1¾ in. lining which gives good service, but we intend to use on future cars two 5 in. end posts of 11.6 lb. per ft. with 2⅜ in. lining for a height of 4 ft. and 1¾ in. lining above that height. This, we feel, will protect any lading that needs protection. If a car gets such rough handling that wheels or rails, or similar lading would break through, it is better to have the boards broken than to distort the posts, as the lining can be replaced at any repair track with a minimum expense, while distorted posts would require sending the car to a steel car repair point. The single thickness end lining makes convenient the application of single thickness, grain-tight end doors.

Out of 30,000 of these cars, 29 have been destroyed. Based on the length of time in service, this would average a loss of approximately one car per 1,000 per year. Of the cars destroyed, 15 were burned, 14 were destroyed in wreck, 10 cars being destroyed on foreign lines. As the loss of cars by fire is in no way affected by the details of construction, I will eliminate them from the calculations. This then, based on the length of time in service would give about one-half car per 1,000 per year destroyed in wreck. As there is no appreciable deterioration of these cars in service, it is safe to assume that in the same service substantially the same rate of loss would continue, while with wooden cars the rate of loss would increase each year.

A conservative estimate shows that there are today approximately 65,000 steel superstructure cars, including outside sheathed, in service. Of this number 30,000 are on the Canadian Pacific Railway and nearly all the remainder belong to the following roads: Chicago, Rock Island & Pacific, Erie, Grand Trunk, Intercolonial, Toronto, Hamilton & Buffalo, Soo Line, Pennsylvania, St. Louis & San Francisco and the Wabash.

STEEL UNDERFRAME BOX CARS.

By George W. Rink, M. E., Central R. R. of New Jersey.

In approaching a subject of such importance to railroads as steel underframe box cars, it is surprising, in view of the interchange of such cars among the railroads, that more has not been accomplished during the past five years toward standardization in design of the various component parts, particularly those which affect the cost of maintenance and require constant repairs due to wear and unavoidable accidents.

During the year 1912, there were built 107,887 box cars of various capacities and dimensions, all varying vastly in detail design of important parts which require frequent renewal, thus making it necessary for all railway storehouses to carry an unnecessarily large stock of repair parts running into very large sums of money. Standards have been adopted by the Master Car Builders' Association which have in a large measure reduced the amount of stock necessary to be carried. I believe the time has arrived to introduce additional standards affecting the maintenance of box cars which can also be applied to all types of freight cars used in interstate business.

It is reasonable to assume that every railroad manager desires to purchase cars built in a substantial manner. In the absence of standard construction and because of competition, the car builders, when asked to furnish estimates and designs, will sometimes figure on material too light for the service. This, however, is not the fault of the car builder, since, from my own experience, I know that they will gladly add the material where needed, provided they are paid a fair price for the car.

From my observation of steel underframe box cars, I must conclude that engineers did not understand the importance of low fiber stresses in the early designs of steel underframes; sufficient attention was not given to the tremendous impact blow which the center sills and car framing found it necessary to resist, with the result that large sums of money are now being spent by railroads in making repairs to these cars by reinforcing broken center and draft sills, applying larger capacity draw gears and attachments, and heavier sills. It is not alone the larger locomotives we are using today which has called for a more thorough investigation of the subject of car design and construction, but also the severe shocks which cars are receiving in classification yards. Also the superstructure of the box cars should receive just as much attention as the underframe, for how can the roofs be kept in alignment on cars having wood side posts and braces and loose tie rods. The roof is bound to work loose, resulting in leaks which prevent the use of the car for certain commodities.

The application of steel underframes to old cars will no doubt prolong their lives. This is now being done by almost every railroad on cars built just prior to the advent of all-steel underframe box cars, but care should be taken to see that sufficient metal is provided to withstand the present service requirements, keeping in view a margin of safety for the future, as no doubt it would be desirable to maintain in service for at least ten years cars to which these steel center sills were applied. The reinforcement of the ends of box cars has received attention by the car construction committee of the Master Car Builders' Association, and they have presented recommendations in the way of designs for old and new box cars. This committee likewise made recommendations with a view to establishing minimum area of center sills to resist end strain.

Railway officials in charge of car repairs have seen the results of poor designing and light construction of the earlier steel underframe cars, and during the past three years have materially assisted in the development of the art by insisting upon the production of a stronger car, one that will hold together in all kinds of service with the minimum cost of repairs.

I have compiled certain relative data from designs of eight wooden upper frame cars and one steel frame car, all of which have inside lining and outside sheathing, also six steel upper frame cars with only inside lining. All of these cars represent the latest designs of box cars now being built or recently placed in service by various railroads. The data obtained has been divided into 15 tables, special cars for automobiles and furniture having been disregarded.

[These tables, though interesting, have not been reproduced owing to the limited space at our disposal. The observations of the author as to the salient facts shown by each follow herewith, however. The data in the tables covers the following roads: Boston & Albany, Canadian Pacific, Central of New Jersey, Chesapeake & Ohio, Chicago & North Western, Delaware, Lackawanna & Western, Erie, New York, Ontario & Western, Pennsylvania, Philadelphia & Reading, Pittsburgh & Lake Erie, St. Louis & San Francisco, Union Pacific and Wabash.—Editor.]

The table of general dimensions for cars with outside sheathing shows that the inside dimensions, such as length and width for 36-ft. box cars are the same with but one exception—the

inside height varies considerably, due to the type of the carline used. The American Railway Association adopted on October 23, 1901, standard inside dimensions for box cars as follows: length, 36 ft.; width, 8 ft. 6 in.; height, 8 ft. No recommendations were made by the Master Car Builders' Association, as requested by the American Railway Association, to establish external dimensions for the 36-ft. box car. The length over sheathing, as shown in the table, varies from 36 ft. 10¼ in. to 37 ft. 1⅛ in., with length over striking plates varying from 37 ft. 7⅝ in. to 38 ft. 8⅞ in., the variation being accounted for by the use of different types of end construction. No doubt these differences will continue on future designs of cars until a standard end frame and end sill construction is made compulsory.

The table of general dimensions for cars with inside sheathing shows similar dimensions for types of steel side frame cars, and it would appear that the inside dimensions, especially of the long cars, are made to suit the whims of various designers. There is really no excuse for such a condition, as it means a further drifting away from the car of standard dimensions which should by reason of duplication in all its parts facilitate repairs, bearing in mind that it is going to be a more costly proposition for railroads to repair, and at times replace, parts of damaged superstructures of steel frame cars than when made of wood. It appears that there was a demand for larger cars than those adopted by the American Railway Association. At a meeting of this body held November 20, 1912, the committee on standard dimensions for box cars, after ascertaining the clearances of various railroads, decided that a box car 40 ft. 6 in. long, 8 ft. 6 in. wide and 9 ft. high was the largest car which could be constructed with due regard for clearances. I believe it undesirable to increase the inside height of the car to 9 ft. on account of increasing the height of the center of gravity of the car from the top of the rail. The present inside cross dimensions should be maintained, and the car should simply be lengthened to 40 ft. in order to obtain increased cubic capacity. A great variation in weight of cars is shown, which leads me to believe that either some of the cars are built too light or others are carrying excess weight in the way of material not properly distributed.

The table for dimensions of wood side framing is very interesting in pointing out what various designers consider necessary in the way of sizes of material for posts and braces which make up the wooden body frame. In 1904 a style of framing recommended by the Master Car Builders' Association, was adopted for cars of 60,000 lb. capacity, and another style for cars of 80,000 and 100,000 lb. capacity. There is this one exception, however, that the Master Car Builders' design indicates the use of one belt rail, whereas, it is now necessary to provide two belt rails in order to properly secure the outside sheathing. This extra rail also adds materially to the rigidity of the side frame, assisting it against end strains.

The table of dimensions of steel side framing shows a comparison in sizes of material used in different members of the steel frame box car. This type of framing, as applied to a large number of box cars recently constructed, lends itself very readily to standard construction; and with the exception of intermediate posts and braces, we are again confronted with a variety of sections and weights of materials comprising the side plate, side sill, corner and door posts. There is no good reason why this condition should continue; these cars will be in service practically all over the country, and barring wrecks, the frames will be subject to the same stress due to impact blows, car lading and weight of superstructure.

In the general designs of steel side frames, standard structural material has been used throughout, with the exception of the Pennsylvania Railroad box cars. The design of frame of this railroad, shown in the photographic illustration, makes a splendid appearance, is well arranged, and provides for vertical inside sheathing. Due to the construction of the posts and braces, slight contact blows from obstructions on neighboring tracks will not affect the appearance of the brace as they will if structural steel is used, which is more liable to distort. However, I am not in favor of pressed steel, on account of its higher first cost as compared with stock rolled steel, and also of the fact that the ends of the posts and braces are flattened out where they connect to the side sill and plate, thus weakening them, especially at the bottom, where depth of the member is desirable to resist bending due to shifting of load or side impact blow.

I prefer a frame construction having nine panels with end panel braced diagonally for cars having an inside length of 40 ft. or over and the same construction for cars 36 ft. inside length, omitting one panel from each side. A diagonal brace has been introduced in the end panel and is in tension due to lading, thus relieving the stress on the side sill near the bolster. It also ties the lower corner of the side frame. If the corner post were to receive an end blow directly over the push pole pocket, with the assistance of an end diagonal it would keep the panel square. Several designs show omission of this brace, but for what reason I do not know, as it could be used to advantage also to secure the inside lining in this panel of wide span.

The question of frame design will depend largely on how the sheathing is to be extended, i. e., vertically or horizontally. The sheathing extends horizontally for all designs of steel frames, except for the pressed steel frame. I believe vertical sheathing is preferable, as it protects the lading against water. In the case of horizontal sheathing, rain can beat in at the joints and the grooves or beading form gutters that have a tendency to deposit the water into the car, both at the door and end posts. This is an important question in the case of cars used for transporting grain. Standard size sheathing should also be adopted, as the table shows that the thickness varies from 1¼ in. to 1⅝ in. and the width from 3¼ in. to 5¼ in. It is reasonable to assume that if all roads having cars built of this type were to use a uniform size of material, it would be far easier and cheaper to make repairs.

The next table shows the various sizes of material used in end frame construction for cars with wood side frames, of which various designs have been introduced. The use of I-beam posts seems to predominate, using wood fillers on each side for securing the belt rails; this forms an ideal construction when the posts are well secured to malleable iron pockets at top and bottom, in connection with a heavy end plate and with bottom pockets riveted to the end sill cover plate. Braces have also been introduced extending, as a rule, from the end sill corner to the end plate adjacent to the posts. No doubt this location is preferable on cars with wood framing on account of the practice of extending the side brace in end panel from the bolster to the top of the corner post.

For securing the end frame against movement at the bottom, due to shocks occasioned by the shifting of loads, an arrangement of angle irons, located on and extending across the top of the end sill and secured by rivets to the top plate, appears to be excellent. This angle iron is placed directly against the posts or sheathing. The former practice is preferable, but it is necessary to cut out the sheathing at the bottom where it laps over the angle iron. Steel plates are also being introduced on the inside of box cars, this plate extending from the floor line to the top of the upper belt rail and well secured to the corner posts by metal bands, which extend back to the door posts. In this construction the end posts are of wood and braced on the outside of sheathing by two pressed steel braces extending across the car, secured to the corner posts. This arrangement was recommended by the Master Car Builders' committee on car construction as a desirable method for rebuilding the ends of wooden cars with Master Car Builders' lining.

It is a known fact that cars built some ten or fifteen years ago were fitted up with a type of end framing which was very light in construction. No post or brace pockets were used in some cases, and in other cases where pockets were

used, the metal reinforcement of the wood posts, such as channels, etc., did not extend into the pocket. When these ends were changed over, with 1¾ in. end lining, no further trouble was experienced. From my personal experience, therefore, I do not believe an all-steel end is necessary to apply to wood side frame box cars.

The next table shows the various sizes of material used in end frame construction for cars with steel side frames. On the Canadian Pacific and Erie, the diagonal brace has been omitted from the side panels; the brace has also been omitted from the end panel on the side frame, and due to absence of both braces, especially the latter, I am of the opinion that the corners of the car are not sufficiently supported, and a side blow on the corner post near the eaves will result in distortion of the entire end of car. For this reason, I believe diagonal braces extending from the side plate to the end sill near the center of car is a very desirable feature.

Z-bars appear to be well adapted for end posts and braces, and where set behind the end sill, the best results will be obtained against strains due to end load shifting, as the entire section of metal in the Z-bar is subjected to shear. In this case it would appear desirable to use channel end sills with steel cover plate. A variety of material is used in the making of end sills. Here is where a standard construction could be made up along with striking plate, push pole pockets, corner post angles, etc., to advantage. Cars with inside sheathing should have end sills designed on standard lines, as it is a part of the car constantly requiring attention, especially in the vicinity of the end sill striking plate.

The end construction for new cars as recommended by the Master Car Builders' car construction committee is evidently worked up on lines similar to those applied to the recent design of Pennsylvania box cars, the difference being in the use of rolled steel instead of pressed steel. I would hesitate to apply this construction to a new car, as I believe a good connection can not be made to the top of the end sill of the single post and two braces as shown. Again, this framing is not adapted to the application of end doors, which a good many roads find desirable to apply on account of the loading of lumber, rails, etc. My preference is for a similar structure, using two posts, instead of one, with a diagonal brace each side, having all posts and braces pass below the top of the end sill, for the reasons already mentioned. The short vertical plate behind the posts is desirable, and along with the wood lining should make a practical arrangement.

The next table gives the sizes of door openings and sizes of doors used on recently constructed box cars. Of all the things which should be made standard, a box car side door is one of the most important. The Master Car Builders' Association now has a door standard, 6 ft. 5 in. wide and 8 ft. high, and it is endeavoring to make this standard for new as well as old equipment. How many railroads are following this practice, which was recommended by their committee in 1910 and adopted as standard in 1912? The table shows that but one railroad—the New York, Ontario & Western—has applied doors of this size.

It has been the practice to use door hangers with rollers, in order to permit the door to slide easily. Some cars were recently constructed with heavy doors, but rollers were omitted from the hangers, and I have learned from good authority that they are not satisfactory, as a great deal of exertion is required to operate them. My recommendation is to continue the use of hangers with rollers. Also sufficient number of door guides, as recommended by the Master Car Builders' Association, is not being applied; they are safeguards against accident if a door hanger should fail, and four guides should be applied, as required.

The height from rail to top of floor varies somewhat from the Master Car Builders' standard of 4 ft. There is no reason for this oversight on the part of motive power officials, and it is of considerable importance, as it permits of standard unloading platform heights all over the country, making it easier for electric freight-handling trucks to enter the cars on the same level.

In the table showing the variety of roofs and roof carlines applied to recent box cars, the number of carlines required seems to be a disputed matter, and evidently has been left to the manufacturer who supplies the roof. The essential requirements for a carline are to support the weight of the roof, with a suitable allowance for additional loading due to accumulation of snow and ice, and, which is of equal importance, to prevent the sides of the car near the eaves from spreading due to lading.

As car roofs are now receiving considerable attention by motive power officials, I will describe the various types in use. They are usually divided into three classes, known as inside roofs, outside roofs, and all-steel roofs. The classification, inside roof, covers all types of car roofs where the metal is inside of the car, and the roof boards over this metal are on the outside of the car. The classification, outside metal roof, covers car roofs where the steel is on the outside of the car, and the roofing boards are underneath. The classification, all-steel roof, covers a car roof in which a heavy sheet is used, usually about 16 U. S. gauge material. In this case, no roof boards are used, either above or under the roofing sheets.

The inside metal roof is the oldest type of roof in service. The original freight car roof consisted of either single or double sheathing of boards on top of the car, but the strain on these roofs was such that they could not be kept without continual repairs. The inside metal roof was then developed, and being made of separate flexible units, permitted weaving of the car to take place and still have a waterproof roof below the roof boards. The outside roof boards are simply a protection to keep the trainmen from walking on the roofing sheets. The advantages of the inside type are: (a) flexibility, (b) protection of the metal from the weather, (c) protection of the metal from trainmen's boots, and (d) prevention of the quick corrosion of the metal, due to the roof boards preventing a deposit of cinders on the metal, which, when attacked by moisture, quickly eats away the galvanizing and also the sheet itself.

The objections raised against this type are that the outside roofing boards work loose, the torsional strains of the car causing the nails to work out and rust off. This condition is usually caused by the weaving of the car superstructure, and can be eliminated to some extent by the use of stronger carlines. An inside roof properly applied as far as the metal is concerned should last a good many years, with the replacement of the roof boards about every four years. These roof boards, besides being secured by nails, are now held down at the eaves by wire staples, locking the boards to the facia.

Of the outside metal roofs, there are numerous types on the market, but in a general way they are similar. Their differences usually are in the method of fastening the sheets at the eaves. The gauge of metal ranges in most cases from 22 to 26 U. S. The advantages claimed for the outside metal roofing are: (a) ease of application, (b) ease of repair, (c) somewhat lower first cost, and (d) possible prevention of fires, particularly in the West.

The objections which develop in this type of roof have been: the exposure of the metal itself to weather and the chafing of the sheets where joined, causing the galvanizing to wear off so that the sheet quickly rusts. Cinders also collect along the eaves where castings are used, and, when wet, sulphuric acid action will set in and eat out the sheet. This is partially overcome by the use of a slip joint along the eaves, as provided for on the later types.

The all-steel type of roof is a development of the last three or four years, and consists of metal plates of about 16 U. S. gauge resting on steel carlines, they being an integral part of the roof. In some cases the sheets extend from side to side of the car, and in others the sheets are divided extending from

the eaves to the ridge pole. The amount of galvanizing used on these sheets is practically the same as that on the outside metal roofs, which is about 1.8 oz. per sq. ft. on both sides of the sheet. The claim is made that this type somewhat lightens the weight of the car, but the same objections have been raised regarding the wearing out of the material as well as the tearing of the metal due to its rigid application. This latter feature is now receiving some attention by the manufacturers, and no doubt can be overcome. This style of roof is more expensive than the other types previously mentioned.

Large sums of money are paid out annually by our railroads to cover damage claims due to wet lading, and the roof problem is a severe one with us. The service requirements, due to the use of heavy power and the severe service that cars are receiving in freight classification yards, compel us to give this matter our earnest attention and assist the manufacturers of car roofs as much as possible in developing a roof that, with ordinary care, will stay tight and protect the lading. Considerable success has been obtained with roofs applied to box cars made up of inside and outside roof boards, having a layer of waterproof roofing material between the boards, similar to that applied to refrigerator cars.

In the application of running boards, there seems to be no standard method followed. The width over all varies from 18 in. to 24 in. and size of material from ⅞ in. to 1½ in. thick and in widths from 5¾ in. to 7½ in. This does not appear on the surface to be a very important matter, but it seems to me that a better understanding should have existed between railroads, at least to arrive at a standard width of platform for the safety of trainmen and a standard size of materials. The Interstate Commerce Commission recommends a standard width of 20 in. and allows a minimum of 18 in. I would suggest, therefore, that all railroads, when applying new running boards to old or new equipment, construct the platform 20 in. wide, using 1⅛ in. by 6¼ in. material.

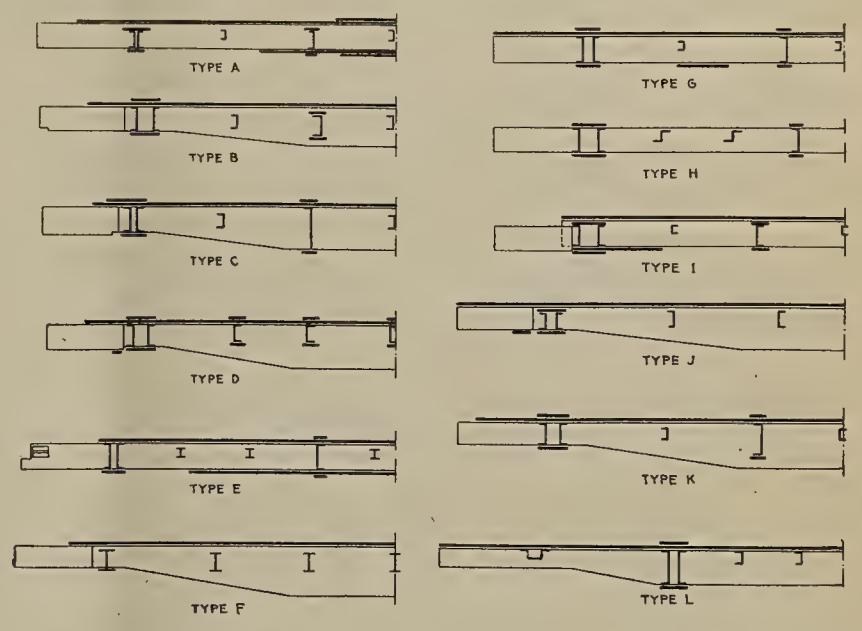
One table shows the spread of body bolsters for box cars of different inside lengths, also distance over striking plates, truck wheel centers, etc. For cars 36 ft. inside length, bolster centers vary from 26 ft. 6 in. to 27 ft. 6 in. and for the longer car this variation is shown from 30 ft. 6 in. to 32 ft. 6 in. The effect of a long overhang of the car from the center line of the bolster to the pulling face of the coupler has a tendency to cause derailment on curves, due to the coupler side clearance in the striking plate not being sufficient to permit the coupler to swing over when the car is coupled with another car that has a short overhang; if derailment does not occur, excessive wheel flange wear is produced. For 36 ft. box cars it would appear desirable to have the bolster centers made 27 ft., which is now standard on a large number of railroads, and allows ample space for the application of draw gear.

For longer cars, the same overhang as obtained under the above conditions for 36 ft. cars could be maintained, which would make the bolster centers 31 ft. for a car 40 ft. long inside. The distance from the face of the striking plate to the outside face of the body end construction should be ample to permit of the proper clearances being maintained for safety appliances, as required by law.

Truck wheel centers vary somewhat, the majority of the railroads now using trucks with wheels spaced 5 ft. 6 in. apart. This I consider very good practice, as it allows ample room for inside brake rigging. Truck arch bars and cast-steel side frames should be designed to interchange with one another, and should conform to the Master Car Builders' requirements. The practice of using various designs of cast-steel side frames which vary in details should be discouraged, as there is no reason why a standard design of truck side frame for the different capacity cars should not be obtained and applied by every railroad in the country. This certainly would simplify repairs, and they could then be purchased in the open market, subject to specifications.

Bolster designs should also be made standard. This is a very important matter, as the life of truck bolsters made of cast steel is uncertain, a number being replaced within five to ten years after cars are placed in service. It would avoid unnecessary delay in obtaining new bolsters for repairs when replacing a built-up design, especially when changing from one manufacturer to another, who, not having a bolster pattern that will interchange, will try to furnish something else or make new patterns, and in the meanwhile cars are tied up at the repair shops. It is manifestly impossible to carry such parts in stock for five to ten different designs for the same capacity car, as this cannot be done without increasing the amount of stock 25 to 50 per cent over the present allowance.

A number of tables have been compiled to show interesting information on the subject of center sill constructions for 14 different cars, the types of underframes used in which are



Types of Center Sills Showing the Diversity in Design, Arrangement of Cross Bearers, Length of Cover Plates, Etc., as Applied to Box Cars With Steel Side Frames.

shown in outline in the illustrations. The heavy lines in the drawings indicate the cover plates used which appear to be a general practice among designers. This is considered by many to be a very desirable feature, and besides adding to the rigidity of the structure, increases the net area of section, and therefore reduces the fiber stress to within reasonable figures.

The strains which an underframe has to withstand vary, and depend a great deal on the design and arrangement of body bolsters, side sills and body framing. With substantial side sills and body bolsters, compressive strains can be transmitted by the latter and thus part of the compressive load can be taken care of by the side sills. However, there is a limit to the load the side sills can take care of, which is based on the ratio of length to the least radius of gyration, the length being considered as the maximum distance between adjacent floor beams. In the case of cars with wood body side framing, it would appear desirable to provide sufficient area at the smallest section of the center sills to take care of end strains, allowing the side sill to carry only its proportions of the vertical loads due to lading, weight of superstructure, and an allowance for oscillation.

In the case of box cars with steel side frames, there is no question about the ability of the frame structure to carry considerably greater loads, both vertically and due to end shock, on account of the diagonal braces assisting in transmitting the strain throughout the side. For this reason, some designers do not consider it necessary to use continuous cover plates on the center sills, but use rolled steel sections for these sills, having a much smaller net area than what is considered good practice by others.

In order to analyze properly the stresses in underframes, a standard method of comparison should be made. Cars do not fail as a rule because of the weight of lading, but principally

because of strains transmitted through the coupler. The magnitude of the end shocks that underframes have to withstand was investigated in tests conducted prior to 1902, on the Lake Shore & Michigan Southern Railway, with a dynamometer car having nominal capacity in apparatus of 300,000 lb. It was found that the tensile and buffing strains, with an engine having a tractive power of 36,000 lb., were from 50,000 to 70,000 lb. and 80,000 to 150,000 lb., respectively, depending upon the skill of the engineer in manipulating the engine, the train remaining intact. In coupling an engine to its train, buffing strains from 65,000 to 142,000 lb. were obtained. Thirty cars moving at about 6½ miles per hour, and coupling on to ten loaded cars with brakes set, gave a shock of 376,492 lb. It would therefore appear from the above results that provisions should be made in designing a steel underframe box car to take care of an impact blow of 350,000 lb. transmitted throughout all sills.

It would therefore seem advisable to assume an end strain of 200,000 lb. on the center sills of box cars with steel side frames and 300,000 lb. for box cars with wood side frames for the reasons previously mentioned. If the center line of coupler was directly on line with the neutral axis of the section to be analyzed, the stress per square inch on the center sills due to end shocks would be equal to the buffing force B divided by the area A of section. In the data compiled in tables on center sills, the area of the sills is given both at the center line of the car and near the bolster. The eccentricity e or the distance from the center line of the draw gear to the neutral axis is also given for these sections. Stress at the bolster due to eccentricity equals $\frac{B_e}{S_t}$ when the center line of the draw gear is below the neutral axis, and $\frac{B_e}{S_c}$ when the center line is above the neutral axis. The combined stress at the bolster equals $\frac{B}{A}+\frac{B_e}{S_t}$ or $\frac{B}{A}+\frac{B_e}{S_c}$, depending upon the location of the center line of the draw gear. At the center line of the car, compression stress due to the lading equals $\frac{M}{S_c}$. Stress due to eccentricity equals $\frac{B_e}{S_c}$. Stress due to end shock equals $\frac{B}{A}$. When the center line of the draw gear at the center of the car is below the neutral axis, the combined stress equals $\frac{M}{S_c}+\frac{B}{A}-\frac{B_e}{S_c}$, and if the center line is above, the combined stress equals $\frac{M}{S_c}+\frac{B}{A}+\frac{B_e}{S_c}$. The ratio of stress to end strain is obtained by the formula $\frac{1}{A}+\frac{e}{S}$, in which S represents the section modulus S_t to be used if the center line of the draw gear is below, and S_c if above, the neutral axis. The car construction committee of the Master Car Builders' Association recommend that the above ratio on new cars should not exceed 0.06. They also recommend a minimum area of 24 sq. in. of center sills.

The tables give the maximum stress on center sills due to vertical loading which was obtained by assuming a uniform load distributed throughout the sill. Calculations are based on the weight of car body, A, the lading, B, and the oscillation, C. The car body weight, A, carried on center sills, was taken at 20,000 lb., except for Philadelphia & Reading box car, in which the weight used was 24,000 lb. (assumed as two-thirds total weight of car body and underframed). The lading B for 60,000 lb. capacity was assumed as 66,000 lb., for 80,000 lb. capacity cars was assumed as 88,000 lb., and for 100,000 lb. capacity cars was assumed as 110,000 lb. The oscillation C was taken at 20 per cent. of the total sum of lading and weight of car body carried.

The calculations for center sill load for box cars with wood side frames were made as follows: load per square inch of floor space

$$w=\frac{A+B+C}{lm}$$

Total uniform load on center sills

$$W=wl(x+y)$$

where

l = length over centers of end posts, in inches
m = distance over centers of side posts, in inches
x = spacing of center sills
y = distance from back of center sill to center of side post, in inches (see diagram)

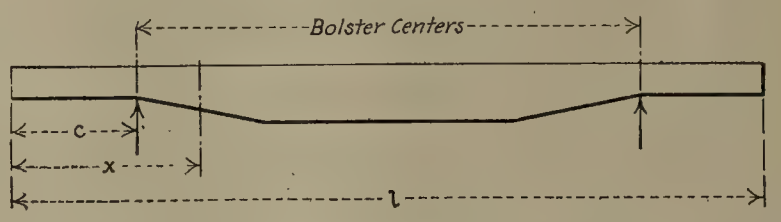


Diagram for Determining Bending Moments

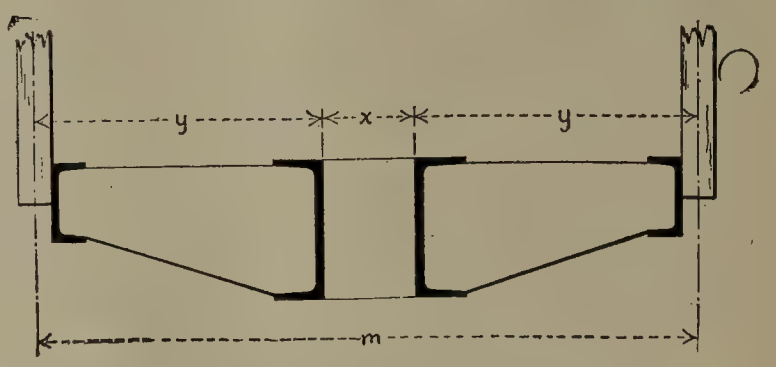


Diagram for Load Distribution.

The calculations for center sill load for box cars with steel side frames were made as follows: load per square inch of floor space

$$w_1=\frac{\frac{A}{3}+B+C}{lm}$$

Total uniform load on center sills

$$W=w_1l(x+y)$$

Bending moment of center sills

$$M=\frac{W}{2}\left(\frac{l}{4}-c\right)$$

where

M = maximum bending moment at center of car
c = distance from center line of bolster to center of end post, in inches
$\frac{M}{S_c}$ = compression per square inch
$\frac{M}{S_t}$ = tension per square inch

Bending moment at any point x

$$M_x=\frac{W}{2}(x-c)-\frac{Px^2}{2}$$

where

x = distance in inches from center of end post to any section between bolster and center of car

P = load per lineal inch of sill

In calculating the Pennsylvania Railroad box car, it was assumed that the cross bearers transmitted to the center sills a certain proportion of weight of the car body, thus producing an additional bending moment in the center sills.

DATA COMPILED ON AREAS AND STRESSES IN CENTER SILLS

AREA OF CENTER SILLS

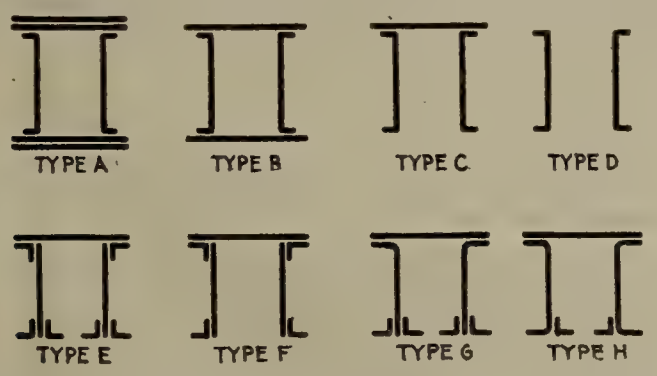
	—At Center—			—At Bolster—		
	Min.	Max.	Aver.	Min.	Max.	Aver.
36-ft. cars, wood frame....	26.84	45.01	33.57	23.90	36.18	26.64
36-ft. cars, steel frame.....	18.73	26.05	22.37	19.80	26.05	22.90
40-ft. cars, wood frame....	32.09	33.125	32.60	19.08	27.30	23.19
40-ft. cars, steel frame.....	26.89	35.91	30.52	22.34	30.68	25.35

MAXIMUM COMBINED STRESS

	—At Center—			—At Bolster—		
	Min.	Max.	Aver.	Min.	Max.	Aver.
36-ft. cars, wood frame..	12787	23519	18321	10220	21124	15809
36-ft. cars, steel frame..	11331	20714	15380	18297	22091	19671
40-ft. cars, wood frame..	13772	23583	18677	29975	35620	32798
40-ft. cars, steel frame..	16909	19831	18391	8715	17713	13095

From the tables on center sills are obtained the data on areas and stresses presented in the table herewith. For the 36-ft. cars with wood body framing, it would appear that the averages shown for the area and stress both at the bolster and the center of the car approach figures which are safe for general practice. For the 36-ft. cars with steel body framing, the average stress per square inch behind bolster is too high for safe practice, and should be reduced by increasing the area. The low combined stress at center of car is due to the center line of coupler being located about 5 inches below neutral axis, which reduces the compression due to direct end shock. At the center of car the stress due to lading alone is also too high for safe operation. For the 40-ft. cars with wood body framing, the average stress per square inch is entirely too high, and should be reduced by increasing the area of the section and cutting down the eccentric load due to end shock; this also applies to the section at the center of the car. In the 40-ft. cars with steel body framing, the maximum combined stress at the center of the car is a trifle high.

In all of these cases it is well to note that the relation of the center line of the coupler to the neutral axis has an important



Typical Sections of Center Sills Showing Lack of Standardization.

bearing on the strength of the sills. At the center of a car with fish-belly type sills, the center line of the coupler is usually above the neutral axis, which adds to the total combined compression; whereas, with rolled steel sills, the coupler center line, being below the neutral axis, will counteract somewhat the compression due to impact blow. This leads me to believe that nothing is gained by making the depth of fish-belly sills at the center any greater than is required to take care of the vertical loads. It will also appear that a fish-belly type sill is necessary for all types of cars mentioned of 80,000 and 100,000 lb. capacity, except 36-ft. steel side frame cars, which will render good service when using a center sill construction of plates and channels.

Another table shows the general practice in designing body bolsters, crossbearers, side sills, and draft sills. For body bolsters, it is general practice to use two pressed steel channels spaced at various distances apart with cover plates top and bottom. The best designs have a spacing 6 in. to 8 in. between webs. For crossbearers, a variety of designs exist, the later types consisting of heavy I-beams passing directly through the center sill web plate and extending the width of the car between side sills. This plan is also followed out on the intermediate floor beams and makes a neat and substantial arrangement. The general practice is to use a pressed steel channel with top and bottom cover plate.

For draft sills, the practice is, where structural steel channels are used for center sills, to extend the same channel to the end sill to serve as draft sills. It has been customary, when fish-belly type center sills are used, to provide a pressed steel Z-shape draft sill and splice to center sill web plate projecting through the bolster. There is a tendency on the part of designers today to do away with the splice by extending the web plates of center sills and providing outside angles to form the draft sill, using a continuous cover plate. Where pressed steel center sills and cover plates are used, the practice has been followed of extending this construction to the end sill, extending the cover plate too near the end of the sill. This construction requires the use of web plates about 5/16 in. thick, so as to provide sufficient bearing area for draft lug rivets. I believe, when draft sills have sufficient net area behind the bolster stop, that considerations of economical construction would warrant dispensing with the splice, as in view of the additional cost of a splice on 1,000 cars, the expense of its application is not warranted when considering the number of sill failures likely to occur due to its omission.

As to draft gears, data regarding the type used have not been tabulated. It is sufficient to say that of the cars enumerated, six were equipped with spring draft gears and nine with friction gears. The impact blow resulting from cars coming together is practically absorbed by the draft gear. Friction gears are more efficient in this respect, absorbing a much greater percentage of total energy as compared with spring gears. This subject has been thoroughly discussed by the members of the Master Car Builders' Association some years ago, a full account of which appears in their proceedings. Owing to the large variety of gears in service, necessitating numerous designs of draft lugs, key attachments, etc., it would appear that, if a standard arrangement of draft gear and all appliances connected therewith were adopted by all railroads, it would result in great economy of maintenance. This should include striking plates and carry irons, which on a large number of cars are not of sufficient strength, due to arrangement of end sills.

An examination of the tables giving the comparative data of various items which enter into the construction of a box car indicates that it is surprising that more has not been done in the way of standard construction. The large expenses which railroads are now compelled to face due to repairs of freight cars could be partially reduced if standard designs were in use throughout the country. Repairs would be facilitated due to the use of standard materials throughout for various types of cars, fewer cars would be held up at car repair shops awaiting material from foreign roads, and interchange of cars would not be a hardship to any railroad, as all cars would be of equal strength. Also drawing room expenses would be reduced both for the railroad and car builder, and repair parts could be produced by cheaper methods than as followed out at present, due to elimination of a variety of designs and shapes, principally castings and pressed steel parts.

The National Association of Purchasing Agents was formed at a meeting held in New York during the latter part of October. Another meeting will be held during the latter part of this month. E. B. Hendricks, box 1406, New York City, is temporary secretary.

CONSOLIDATION LOCOMOTIVES, W. & L. E. R. R.

Twenty consolidation locomotives have recently been delivered to the Wheeling and Lake Erie Railroad by the American Locomotive Company. Having a tractive power of 55,900 pounds, combined with a boiler capable of sustaining this power, these engines become the leaders of their type. They deserve special study, especially just at this time when many roads are adopting the Mikado type. They demonstrate the possibilities of the further development of the consolidation engine which has recently almost become forgotten. On roads where freight service does not demand a speed greater than that which can be obtained economically by 57 inch wheels, the consolidation should be the preferable type.

The Lackawanna Mikado was chosen to be used in the following comparison because it is considered one of the best Mikado designs:

Road.	W. & L. E.	D. L. & W.
Type	280	282
Tractive power	55,900 lbs.	57,100 lbs.
Cylinders	26x30″	28x30″
Driving wheels	57″	63″
Boiler pressure	185 lbs.	180 lbs.
Weight on drivers	236,000 lbs.	237,000 lbs.
Total weight of engine	266,500 lbs.	312,500 lbs.

The sustained higher speed demanded of the Mikado required the 63 inch wheel, larger diameter of cylinders, and increased boiler capacity. By reducing this speed to within the range of a 57 inch wheel, a saving of 17.4 per cent. in weight was secured with a reduction of only 2.2 per cent. in maximum power.

Comparison of Boilers.

Type.	W. & L. E. Wagon top	D. L. & W. Straight top
Outside dia. of front end	82″	86⅛″
Outside dia. of back end	89″	89⅞″
Tubes, number and diameter	293—2″	304—2″
Flues, number and diameter	43—5⅜″	43—5⅜″
Tube length	15′-6″	21′-0″
Firebox length	114″	108″
Firebox width	84¼″	84¼″
Heating surface, tubes and flues	3,293 sq. ft.	4,593 sq. ft.
Heating surface, firebox	224 sq. ft.	234 sq. ft.
Heating surface, arch tubes	...	27 sq. ft.
Heating surface, total	3,517 sq. ft.	4,854 sq. ft.
Superheating surface	774 sq. ft.	1,085 sq. ft.
Grate area	66.8 sq. ft.	63.1 sq. ft.

Both these boilers were designed by the builder's new standard boiler proportions. They are known as 100 per cent. boilers and were guaranteed to furnish a constant supply of steam for any sustained speed the locomotive cylinders are capable of making. These new proportions represent a radical change in boiler designing. All the variables, such as steam pressure, tube length, tube spacing, grate area, etc., are considered. It is also known that the American Locomotive Company is to publish these ratios in bulletin form in the near future.

The increased heating surface of the Mikado is due mainly to the 5½ feet additional tube length. The faster speed of the Mikado, with its 63-inch wheels demands this increase. However, the value of this heating surface is not as great as it appears, due to the fact that the evaporative value per foot of length is greater for short tubes than for long tubes.

A sufficient depth of throat has always been a serious problem with the consolidation engine. By slightly raising the center of the boiler and taking advantage of the reduced wheel diameter, a firebox depth, from the top of grate to the center of the lowest tube, of 24¾ inches was secured. The Lackawanna Mikado, having the advantage of a trailing truck, has a similar dimension of 24 inches. The center of the boiler for the Consolidation is 124 inches above the rail, as against 120 inches for the Mikado.

Other interesting features included in the consolidation design are, a superheater, long main driving box, Woodard engine truck, Foulder design of main rod back end, screw reverse gear, and vanadium cast steel main frames. A firebrick arch was applied to one engine. All engines were arranged so that the street stoker and arch tubes could be applied later.

These engines have been put in service in the Toledo division, between Brewster and Huron, a distance of 72 miles. This division is composed of short broken grades. With the exception of a 5 mile grade of 1.15 per cent. which requires a helper service, the ruling grade is 0.5 per cent. against east-bound traffic and 0.4 per cent. against west-bound traffic.

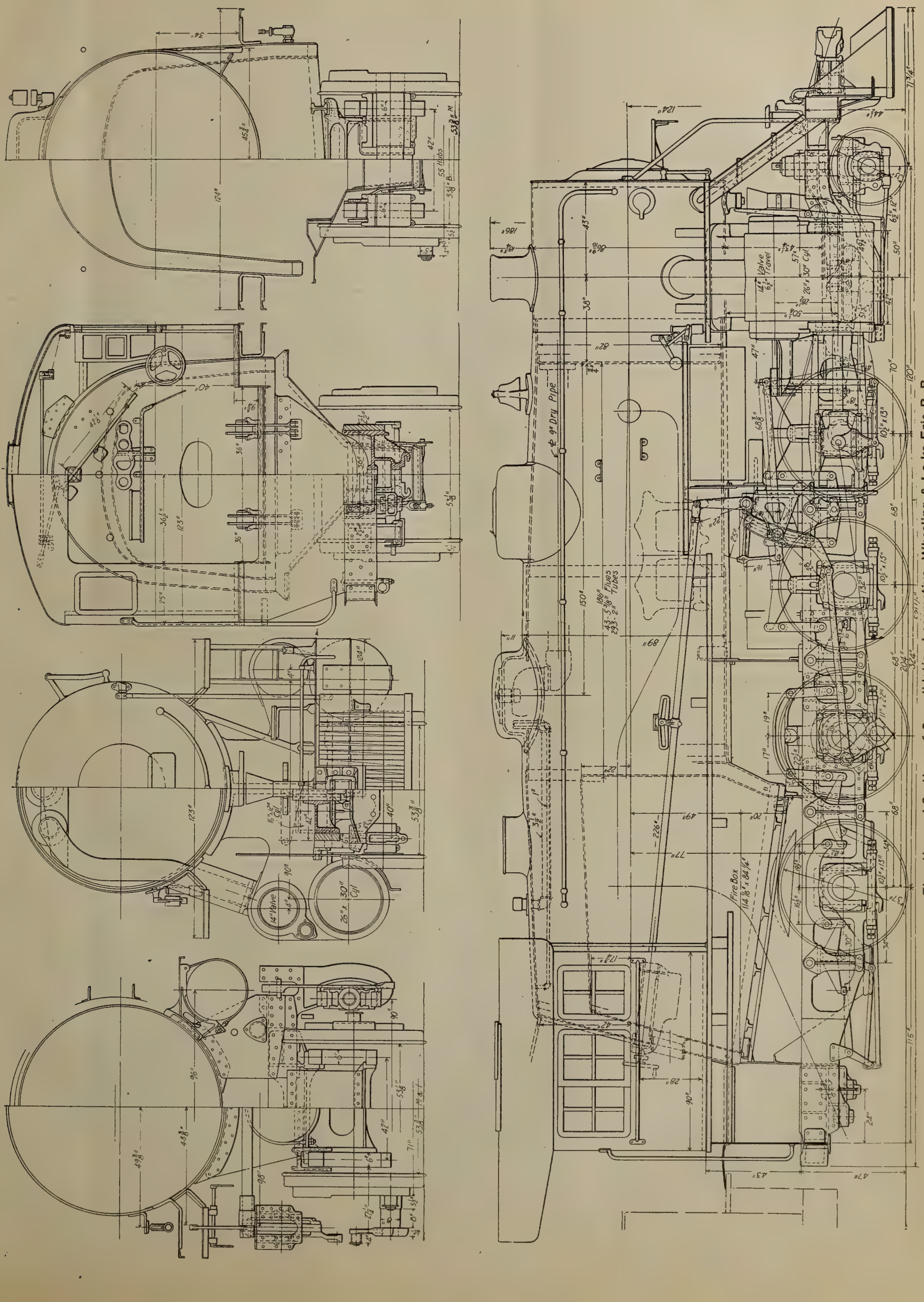
Consolidation for the Wheeling & Lake Erie.

All of the engines are not as yet in service, but on the basis of their tonnage ratings, the 20 new engines will supplant 27 former consolidations having a tractive power of 41,360 pounds.

The new consolidations are handling 3,310 tons east-bound, and 3,575 tons west-bound, at an average speed of 20 miles per hour. Old consolidations handle 2,310 tons east-bound, and 2,645 tons west-bound. East-bound train loads have thus been increased 35.4 per cent., and west-bound train loads, 35.1 per cent.

The average coal burned per trip is 15,560 pounds, average coal per ton mile, .0636 pounds. Average water per trip is 14,416 gallons, average water per ton mile, .0589 gallons.

F. T. Hyndman, superintendent of motive power advises that, although the engines have not been in service a sufficient time to prove their merits, from a general observation it appears that the engines are very efficient and economical. They steam very freely and give no trouble whatever from lack of steam when properly fired.


Valve Travel
30" Cyl
Fire Box
Elevation and Sections of Consolidation Locomotive, Wheeling & La ke Erie R. R.

The principal dimensions are as follows:

Gauge	4'-8½"
Fuel	Bituminous Coal
Weight in working order	266,500 lbs.
Weight on drivers	236,000 lbs.
Weight on engine truck	30,500 lbs.
Weight, engine and tender	443,800 lbs.
Wheel base, rigid	17'-0"
Wheel base, engine and tender	62'-3"
Wheels, driv., dia. outside tire	57"
Wheels, engine truck, dia.	33"
Wheels, tender truck, dia.	33"
Axles, driv. journals, main	11"x22"
Axles, eng. truck journals	6½"x12"
Axles, tender truck journals	6"x11"
Firebox	114"x84¼"
Firebox water spaces	5"
Crown staying	Radial
Tubes, No. and dia.	293—2"
Tubes, length	15'-6"
Flues, No. and dia.	43—5⅜"
Heating surface, tubes and flues	3517.1 sq. ft.
Heating surface, firebox	3293.4 sq. ft.
Heating surface, total	223.7 sq. ft.
Superheating surface	774 sq. ft.
Grate area	66.75 sq. ft.
Cylinders	26"x30"
Valves	14" piston
Tank, style	Water bottom
Tank, water capacity	9,000 gallons
Tank, fuel capacity	15 tons
Tractive power	55,900 lbs.
Factor of adhesion	4.22

ASH PAN, CANADIAN NORTHERN RY.

About a year ago the mechanical department of the Canadian Northern made a collection of the designs of about fifty different ash pans, and, after a careful study of them, evolved a pan embodying the best points of all. This pan, which is of the hopper type, is shown in the illustration, and was mentioned in the description of the consolidation locomotives for this road on page 481 of the October issue of the *Railway Master Mechanic*. The hopper doors each have a lug at the lower corner which is attached to a bar connecting all the doors, and this bar is connected up to a bell crank and lever. Operating levers are applied to both sides of all engines now built. The hopper pan is made of ⅜" plate and the one illustrated has a bottom measurement of 11¾" x 22¼". The upper edge of the pan is reinforced by a 2" x 2" x 7/16" angle riveted to the inside and a similar angle riveted to the lower outside edge.

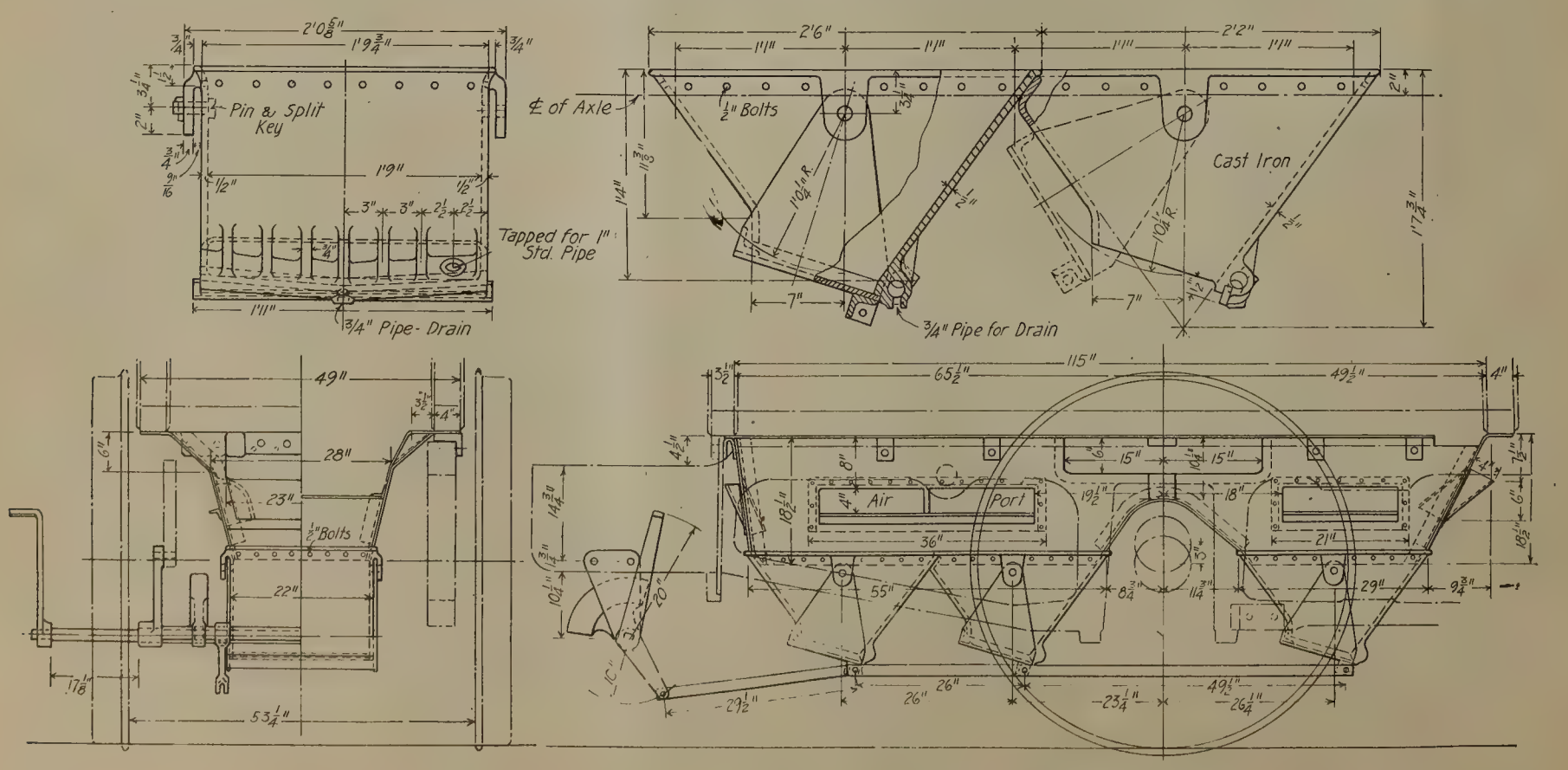
The hoppers are made of cast iron, ½" in thickness. At the lowest point they are tapped for a ¾" standard pipe drain. The sludge pipe is connected to the left-hand injector only, and is 1¼" pipe. At the end a T and cross pipe is inserted. The cross pipe is plugged at each end and forms a branch support which rests on the bevel at the end of the pan. The air port openings are of cast iron, with an opening 4" high. This pan is being put in service on all power for the Canadian Northern.

FRAUDULENT RECOMMENDATIONS.

A novel form of fraud has developed in a system of selling forged certificates of satisfactory former employment on railroads. So many cases have come to light where railroads have been deceived by forged papers, apparently signed by Pennsylvania Railroad officers, that the company has undertaken an exhaustive investigation.

Most of the forged letters that have been located so far have purported to come from the Schuylkill division of the Pennsylvania and they have been presented by applicants for work to California railroads. Accordingly, a searching inquiry was made in San Francisco, in which place a number of the certificates had been traced. Here it was learned that the proprietor of a cigar store made a charge of $1.00 for a forged letter of recommendation. He had an accomplice in a stenographer in a shop nearby, who, for the sum of twenty-five cents, would add a few pencil notations to give a letter some look of genuineness. Whether there are other such merchants in the West has not yet been learned, but the search for them is being continued.

The forged letters first appeared in the summer of 1912, and since then have been appearing with much frequency. One was supposed to have been signed by C. A. Preston, former superintendent of the Pennsylvania between Harrisburg and Altoona, but all of the others bore the forged signature of A. W. Moss, late superintendent of the Schuylkill division. On one of the letters Schuylkill was spelled "Schoolkuyl," while on another Mr. Moss's name was spelled "Morse."



Ash Pan, Canadian Northern Ry.

Billerica Shops, Boston & Maine R. R.

Owing to the lack of capacity for repairing equipment, both car and locomotive, the Boston & Maine in the latter part of 1910 commenced the preliminary work for the construction of large repair shops near North Billerica, Mass., on a large tract of swampy ground purchased for the purpose. Previously the repair work on locomotives was distributed between Concord, N. H.; Lyndonville, Vt.; Keene, N. H., and Boston, Mass. All car work was distributed between Concord, N. H.; Fitchburg, Mass., and Boston, Mass. Billerica was selected as the most conveniently located available site.

General View, Billerica Shops, Looking North. Locomotive and Power Houses at Right, Passenger Car Buildings at Left.

The buildings now completed are as follows:

Locomotive erecting shop.	Dry kiln.
Coaling plant and cinder pit.	Car machine shop.
Stripping shed.	Car blacksmith shop.
Lye vat house.	Oil house.
Tire house.	Iron shed.
Blacksmith shop.	Passenger car shop.
Power house.	Paint shop.
Store house (and office).	Paint, varnish and oil house.

The lay-out includes plans for freight car shop and a planing mill in addition to the above. These buildings have not yet been constructed.

All of the main buildings are of steel frame brick construction, the steel work having been fabricated by the McClintic-Marshall Co. In aranging for foundations and trackage five hundred and sixty thousand feet of cut and filling earth was moved in grading. Of this work one hundred thousand yards was moved by the railway forces, the balance being handled by contract with the Wilson & English Construction Co., New York.

The foundations for all main buildings are on concrete piles of the McArthur "Pedestal" type This work togethed with piers for columns was handled by the McArthur Concrete Pile & Foundation Co., of New York.

Nearly all of the buildings were constructed by W. M. Pike & Sons Co., of Lawrence, Mass. These buildings are of the monitor roof design with skylights manufactured by the National Skylight and Ventilating Co., of Rochester, N. Y., the roofing itself being the Barrett Specification.

Hot water for heating is supplied for all buildings from engine condensation in the power house.

Locomotive Erecting Shop.

This shop is of the conventional longitudinal design. The building is 838 feet long by 160 feet wide and has a gallery for light machinery with crane service three-fourths of the length of the building.

This shop has three tracks running its entire length, the center track being equipped with two pits. Crane service is supplied by two 65-ton, one 10-ton and one 7-ton traveling bridge. In the machine bay are two 10-ton cranes with several power trolleys operating in connection. The tank and boiler section has one 35-ton crane.

The flooring is of concrete on tamped gravel. The heavy machines are on concrete foundation. This shop is designed to turn out from forty to fifty engines per month and is arranged for large future extensions.

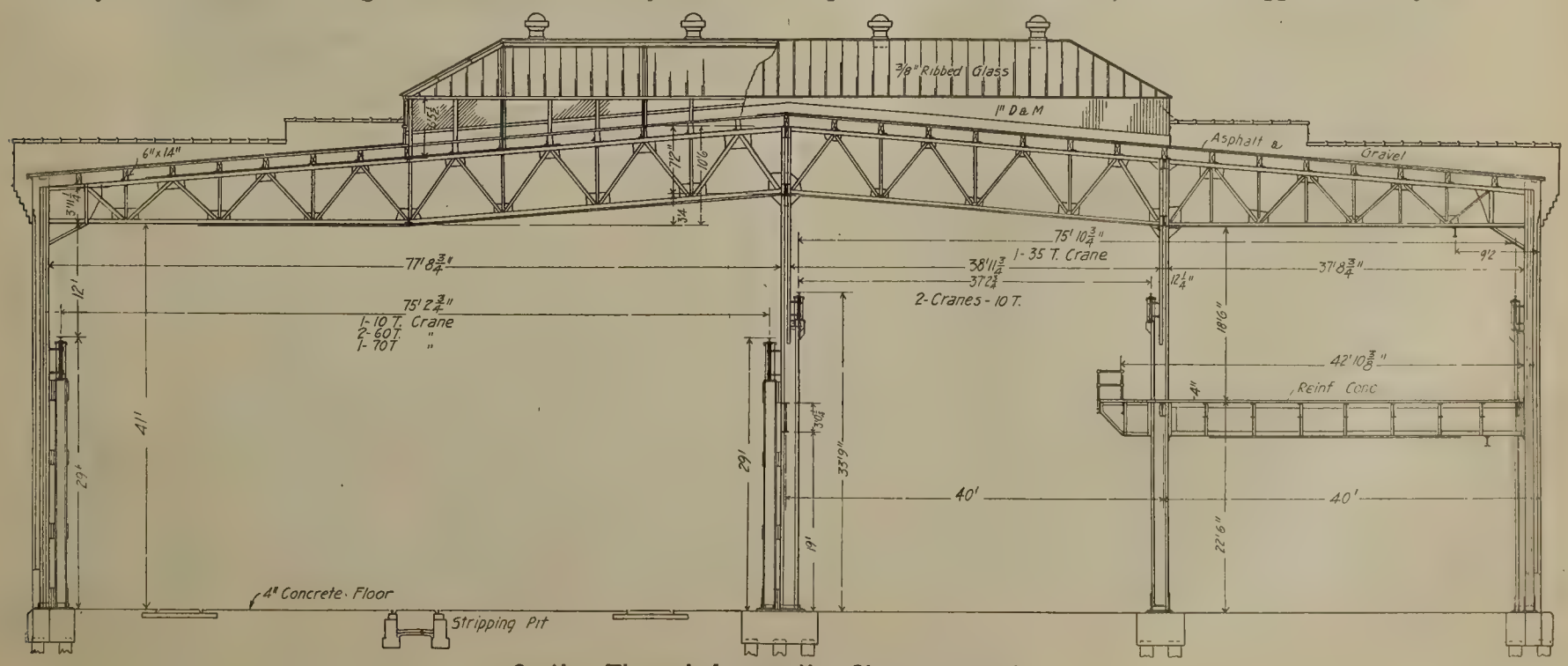
Blacksmith Shop.

This building is equipped with one track extending through from the erecting shop. The shop has twelve McCaslin double forges and six steam hammers. There are also four forging machines and one air hammer. The floor is of clay and cinders mixed and rolled.

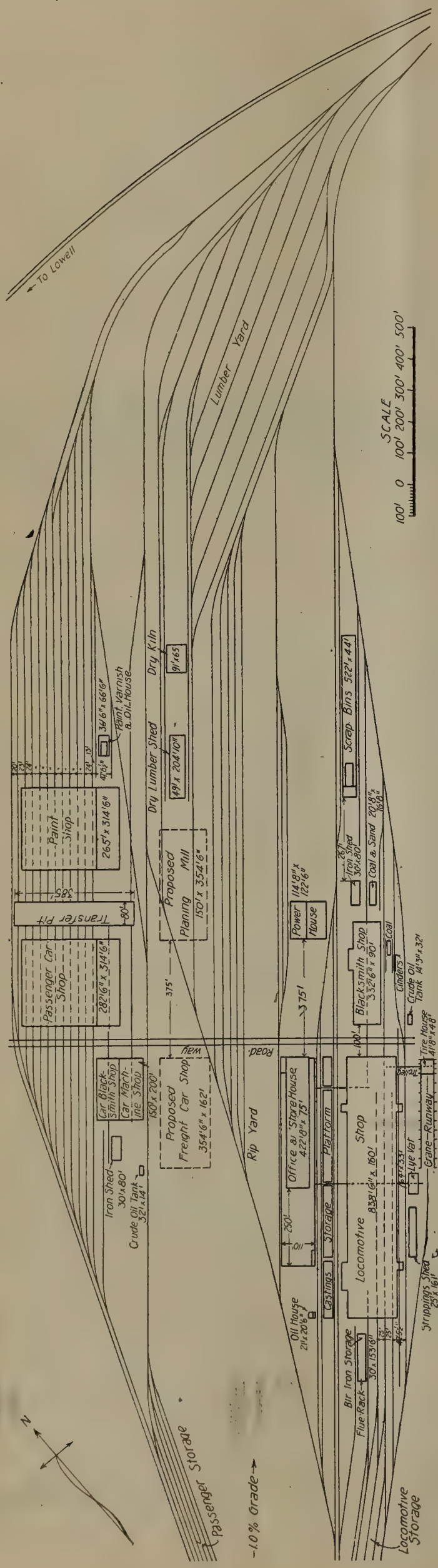
This building is also arranged for future extension and is at present 332 feet long by ninety feet wide.

Storehouse and Office.

The north end of the storehouse building is used for the general shop office. It is constructed with two stories and in the office section the lower floor is to be used by the shop superintendent and staffs, and the upper floor by the store-



Section Through Locomotive Shop at Billerica.



General Layout, Billerica Shops.

Interior of Storehouse, Second Floor.

keeper and staff. The building is of mill construction with a wooden floor on the second story and a concrete floor on the lower story.

The building is 672 feet long by 110 feet wide and an elevator is located at each end of the stores section. These elevators are operated by electric hoists. A large material platform with track facilities extends the length of the building.

Power House.

The power house is 120 feet long by 114 feet wide. It is equipped with five 100-H. P. Babcock & Wilcox boilers arranged in two batteries and fed with Murphy stokers. The remaining boiler is hand fired for the purpose of burning chips and shavings.

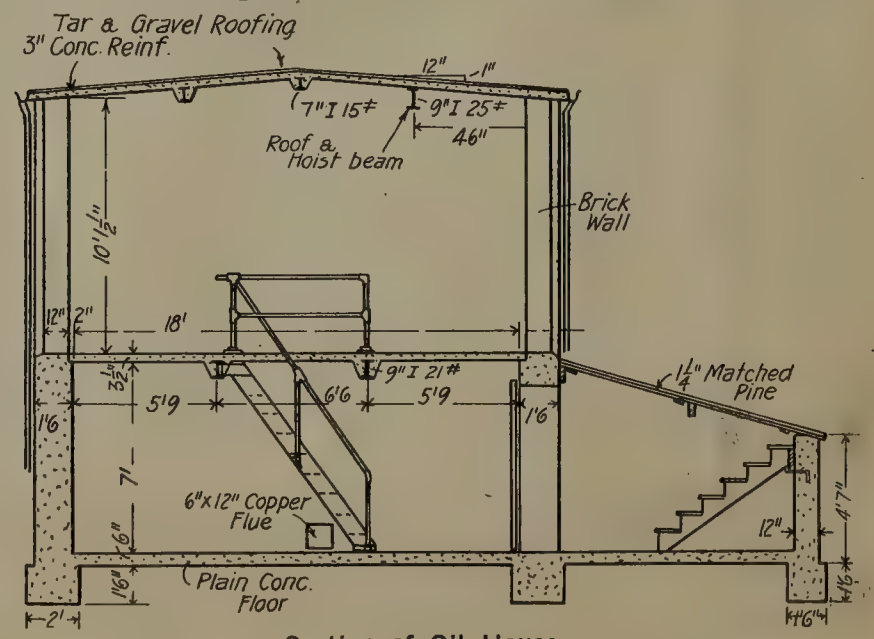
These boilers are connected for induced draft with a 14-foot fan.

A 12-inch main steam header near the floor at the rear of the boiler supplies steam directly for the two main engines and through an auxiliary header in the condenser room supplying the other machinery.

The feed water for the boilers is furnished by two high duty pumps located in the pump room. An additional supply can be furnished through injectors. In the boiler room are also located two fire pumps, which also force service water through the plant.

In the engine room are two 350-K. W. Rice & Sargent duplex engines direct connected to General Electric three-phase alternators. The excitation current is furnished by two 50-K. W. General Electric marine type direct current units or by a motor-generator set.

There are two duplex air compressors of 3,000 feet capacity each and a 750-K. W. low pressure Curtis turbine located in the engine room. The turbine is operated by the exhaust steam of the engines and is connected with the condensor



Section of Oil House.

Interior of Locomotive Shop Looking North. Billerica Shops.

which with its turbine driven air and circulating pumps is located in the basement.

The circulating water comes from and returns to a cooling pond where the water is cooled by a set of spray nozzles.

The exhaust steam is also used to lead the water in the leading system for all the buildings, the heated water being circulated by turbine driven centrifugal pumps.

A semi-automatic conveying system is used for handling coal and ashes.

Car Blacksmith and Machine Shop.

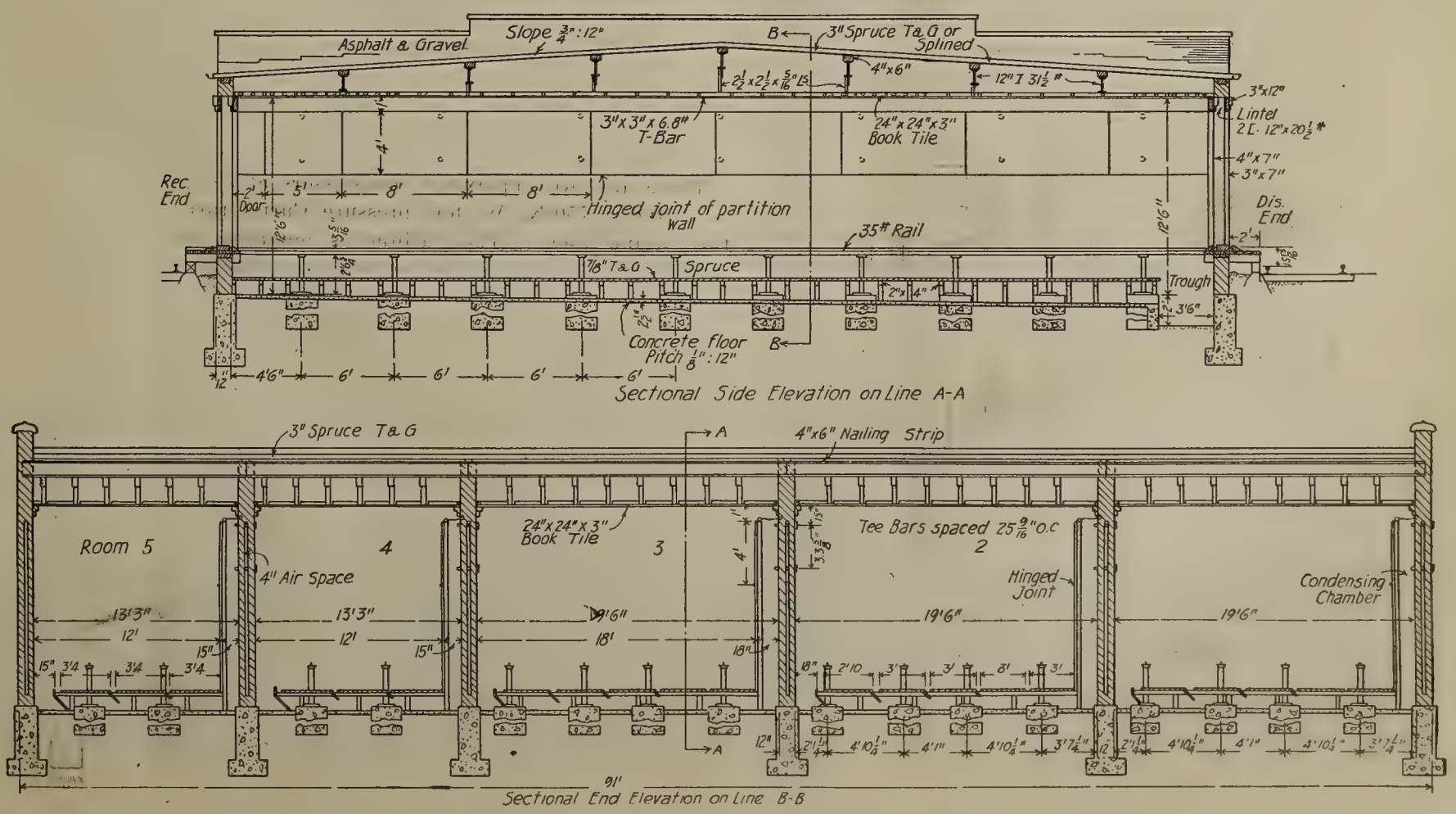
This building is 200 feet long by 150 feet wide. The blacksmith and machine departments are separated by a fire wall. The flooring is of concrete in the machine room and of clay and cinders in the smith room. One track runs through each department.

Passenger Car Shop.

This building is 282 feet long by 314 feet wide. It is constructed with concrete floors and has ten tracks running to the transfer table pit between this shop and the paint shop. The transfer table pit is equipped with a tractor made by G. P. Nichols & Bro., of Chicago.

Passenger Car Paint Shop.

This building is 265 feet long and 314 feet wide to match the repair shop. It also has ten tracks served by the transfer table. It has concrete floors and no pits.



Dry Kiln, Billerica Shops.

Blacksmith Shop. Crude Oil Pit, Gantry Crane for Coal and Ash Handling, and Sewage Pump House in Foreground.

General.

The grading for the entire job was performed in part by the company's forces and in part by the Wilson-English Construction Co., of New York.

The concrete piles and foundations were constructed by the McArthur Concrete Pile & Foundation Co., of New York.

The structural steel was fabricated by the McClintic-Marshall Co., New York.

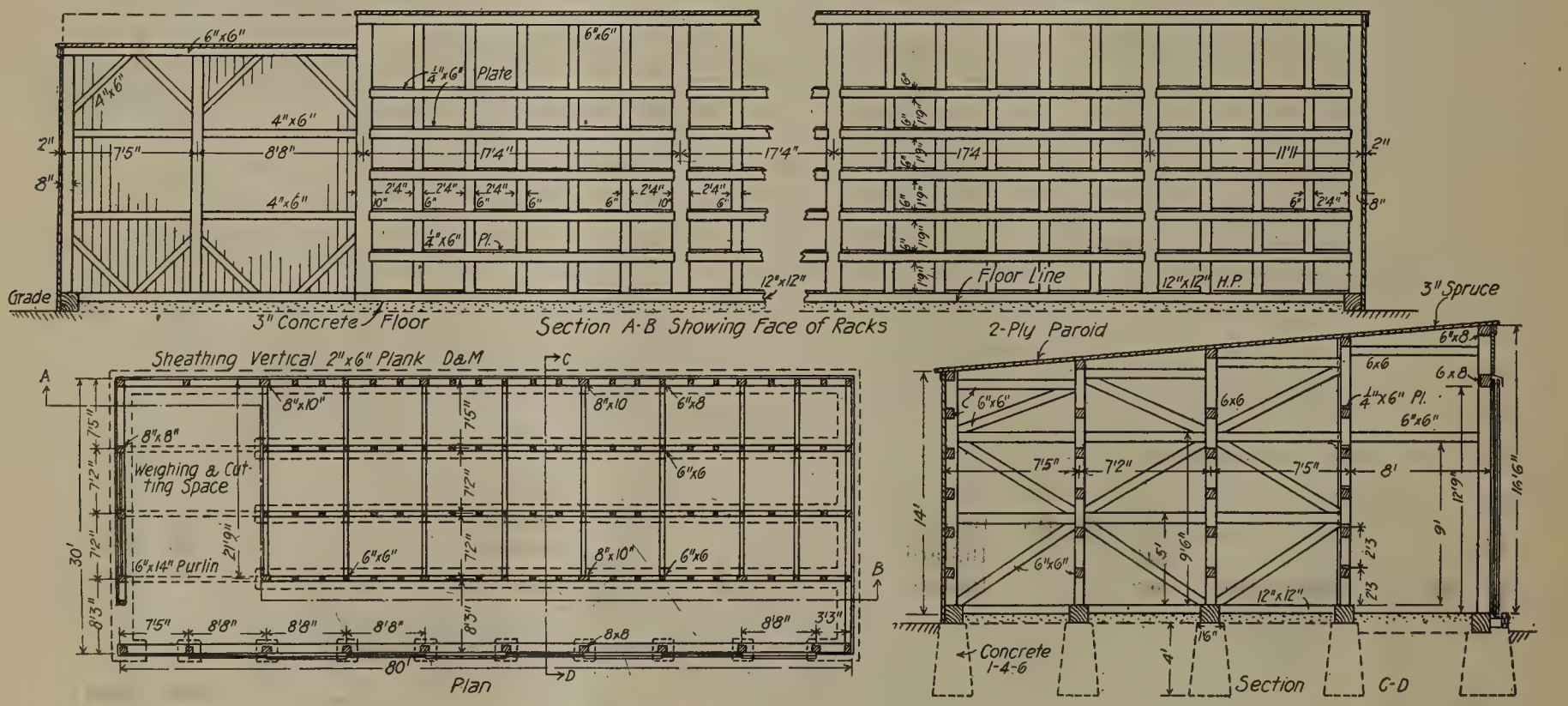
The general contract for superstructure was fulfilled by W. N. Pike & Sons, Lawrence, Mass.; three of the buildings, however, and the sewerage system were constructed by the C. A. Dodge Co., Cambridge, Mass.

The sprinkler and hydrant system was installed by the General Fire Extinguisher Co., Boston, Mass. The heating system was designed and constructed by the Jennison Co., Fitchburg, Mass. The wiring and transmission was handled by the railway forces.

Trackage, totaling twenty-five miles, with 120 switches, was constructed principally of relay steel by the railway forces.

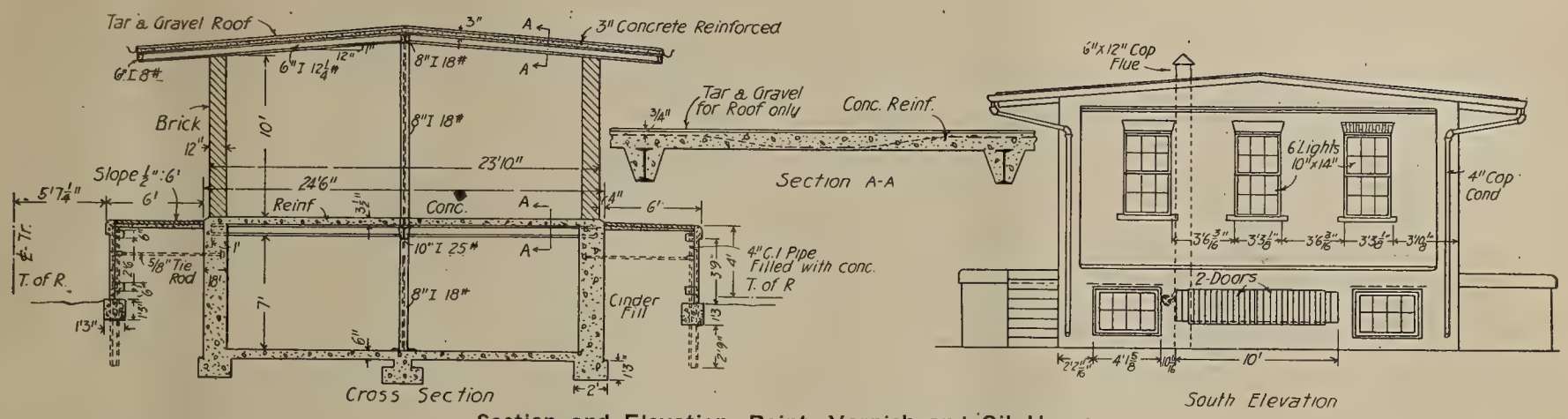
The oil storage system is that manufactured by the S. F. Bowser Co., Ft. Wayne, Ind.

Those connected with the railway company who have been instrumental in carrying the work to completion are as follows: F. K. Irwin, special engineer, who had charge of design and



Plan and Sections of Iron Storage Shed.

Passenger Car Shop at the Left. Passenger Paint Shop at the Right.



Section and Elevation, Paint, Varnish and Oil House.

construction from inception to September, 1913; Henry Bartlett, mechanical superintendent, who was, of course, in charge of the machinery lay-out; F. C. Shepherd, engineer construction, who was given charge of the work after September 1, 1913; F. D. Hall, electrical engineer, who was in charge of power plant insulation, wiring, lighting, etc.; and S. P. Coffin, assistant engineer, who was actively in charge of the forces on the ground from the beginning of the work in January, 1911, to completion.

Locomotive Shop.

No.	Machine.	Dimensions.	Make.
1	Lathe	14″x6′	Prentiss
3	Lathe	16″x8′	Prentiss
1	Tools	18″x8′	Prentiss
9	Lathe	18″x8′	Prentiss
3	Lathe	20″x12′-10′-8′	Prentiss
4	Lathe	24″x14′-10′	American
1	Pistons	26″x12′	American
3	Lathe	26″x12′	American
1	Lathe	36″x14′	N. H. Mfg. Co.
1	Lathe	42″x20′	N. H. Mfg. Co.
1	Lathe	24″x9′	American
2	Lathe	14″x5′	Prentiss
2	Lathe	90″	Putnam
2	Lathe	3″x36″	Jones & Lamson
3	Lathe	2″x24″	Jones & Lamson
1	Lathe	20″x7′	Warner & Swasey
4	Brass Lathe Turrets	18″	Warner & Swasey
1	Screw Machine	1½″	Dreses
1	Boring Mill	42″ Dbl. Hd.	Bullard
1	Boring Mill	51″ Dbl Hd.	Bullard
1	Boring Mill	72″ Dbl. Hd.	Gisholt
1	Boring Mill	84″ Dbl. Hd.	Betts
2	Turret Mills	24″	Bullard
3	New Era Turret Mills	36″	Bullard
1	New Era Turret Mills	42″	Bullard
2	Horiz. Boring Machines		Lucas
1	Rod Borer Dbl. End		Baker Bros.
5	Drills	44″	Foote-Burt
2	Drills	40″	Niles-Bement-Pond
1	Drill	36″	Baker
3	Drills	32″	Niles-Bement-Pond
3	Drills	25″	Foote-Burt
2	Friction Drills	14″	Prentiss
3	Sensitive Drills	16″	Prentiss
2	Plain Radial Drills	4′	Prentiss
3	Plain Radial Drills	5′	Fosdick-Taylor
3	Plain Radial Drills	6′	Prentiss
1	Univ. Radial Drill	5′	American
1	Univ. Radial Drill	6′	American
1	Planer	72″x72″x30′	Pond
2	Planers	52″x54″x10′	Pond
1	Planer	42″x42″x12′	Pond
2	Planers	36″x36″x10′	Pond
2	Planers	36″x36″x12′	Pond
3	Planers	30″x30″x10′	Woodward
5	Crank Planers	24″x24″x24″	Cincinnati
1	Pillar Shaper	14″	Stockbridge
1	Pillar Shaper	20″	Cincinnati
2	Crank Shapers	24″	Cincinnati
1	Sg. Hd. Traverse Shaper	18″	Cincinnati
1	Dbl. Hd. Traverse Shaper	22″	Cincinnati
1	Morton Draw Stroke	32″	Morton
2	Slotters	12″	Dill
1	Slotter	15″	Betts
2	Slotters	20″	Dill
2	Slot Millers	30″x10′	Ingersoll
1	Rod Miller (Slot)	48″	Ingersoll
1	Vert. Miller	42″	Bement
1	Vert. Miller	33″	Bement
1	Vert. Miller	18″x49 Platen	Becker
1	Piston Rod Keyway Miller		Niles-Bement-Pond
1	Plain Miller	24″x7″x19″	Becker
1	Plain Miller	14″x72″	Brainard No. 2
			Brainard No. 4
2	Univ. Millers	30″x10″x19″	Brown & Sharpe
1	Whl. Press	90″	Wood
1	Power Press	50 ton	Lucas
1	Power Press	30 ton	Lucas
1	Double Bolt Cutter	1½″	Landis
1	Centering Machine	½″x7′	Whiton
1	Guide Grinder	12″x12″x72″	Springfield
1	Piston Rod Grinder	18″x30″x96″	Norton
1	Link Grinder		Hammett
1	Univ. Tool Grinder		Sellers
2	Twist Drill Grinders		Sellers
1	Cutter and Reamer Grinder		Morse No. 2
1	Milling Cutter Grinder		Beck-Brain No. 1
1	Cutting-Off Grinder		Armstrong
1	Buffer and Grinder, No. 17	14″x2″	Bridgeport
1	Swing Grinder		Bridgeport
4	Wet Emery Grinders	24″x3″	Springfield
6	Dbl. Grinders	18″x3″	Blount No. 6
4	Dbl. Grinders	14″x2″	Bridgeport
1	Bench Grinder	12″x2″	Blount No. 2
1	Auto Valve Grinder	8 Spindle	Ryerson
1	Power Squaring Shears		Niagara No. 342
1	Pipe Cutter	3″	Stoever
1	Pipe Cutter	4″	Stoever
1	Pipe Cutter	12″	Stoever
1	Pipe Bender, No. 3		Ped. & Smith
2	Cylinder Boring Bar	6″	Ryerson
2	Valve Chamber Boring Bars	4″	Ryerson
1	No. 2 Cylinder Facer		Underwood
2	Valve Seat Planers	26″	Underwood
3	Valve Setting Machines		Harrington-Mills
1	Staybolt Nipper		Helwig
1	Tank Riveter		Albree
6	Hoists	2 ton	Canton No. 3

No.	Machine.	Dimensions.	Make.
1	Radius Planer Attachment		Underwood
1	Bending Rolls	15′	Niles-Bement-Pond
1	Bending Rolls	8′	Cleveland No. 1
1	Hand Bending Rolls	4′	Hillis & Jones
1	Plate Straightening Rolls		Hillis & Jones
1	Rotary Splitting Shear		Lenox
1	Rotary Bevel Splitting Shear		Lenox No. 3
1	Plate Shear	48″	Hillis & Jones No. 3
1	Plate Shear	60″	Hillis & Jones No. 2
1	Vert. Punch	36″	Massillon
1	Vert. Punch	60″	Hillis & Jones
1	Horiz. Flange Punch		Hillis & Jones
1	Pneu. Flanging Clamp		Hillis & Jones
1	Flue Cleaner		Ryerson
1	Flue Welder		Ryerson
1	Flue Hot Saw and Expdr		Ryerson
1	Flue Swadger, Pneu		Ryerson
1	Flue Cutter		Ryerson
1	Flue Safe-End Cutter		Ryerson
1	Air Hammer, Motor Driven	66 Pounds	Beche-Hazel
1	Bar Iron Shears		Oeking
7	Portable Rivet Forges		Ferguson
1	Portable Machinist's Forge		Buffalo
1	Portable Oil Heater		Ferguson
1	Portable Oil Heater		Ferguson
1	Acetylene Welding Outfit		Ferguson
1	Furnace—Annealing	9′x14′	Ferguson
2	Babbitt Melting Furnaces		

Car Machine Shops.

1	Lathe	18″x6′	Prentiss
1	Lathe	50″x16″	N. H. Mfg. Co.
2	Dbl. Car Axles		Bridgeford
1	Dbl. Car Axle		Niles-Portsmouth
1	Car Wheel Lathe	42″	Putnam
1	Car Wheel Borer	54″	Wm. Sellers & Co.
1	Drill	36″	Baker
1	Drill	32″	Niles-Bement-Pond
1	Drill	25″	Foote-Burt
1	Sensitive Drill	16″	Prentiss
1	Planer Pond	36″x36″x10′	Niles-Bement-Pond
1	Crank Planer	24″x24″x24″	Cincinnati
1	Pillar Shaper	14″	Stockbridge
1	400-ton Wheel Press	90″	Wood
1	400-ton Wheel Press	44″	Wood
1	Single Blot Cutter	2½″	Landis
1	Speed Lathe		Whiton
1	Twist Drill Grinder		Sellers
1	Bench Grinder	12″x2″	Blount No. 3
1	Journal Box		Springfield
1	Pipe Cutter	4″	Stoever
1	Pipe Bender, No. 3		Ped. & Smith
1	Power Hack Saw		Royal

Blacksmith Shop.

1	Drill	40″	Niles-Bement-Pond
1	Spindle Staybolt Drill	4 Spindle	Ryerson
1	Staybolt Cutter	4 Spindle 1½″	Lassiter
1	Triple Bolt Cutter	1½″	Landis
1	Double Bolt Cutter	1½″	Landis
2	Bolt Pointers	2″	National
1	Dbl. Hd. Taper Bolt Turner	1½″	Pawtucket No. 2
2	Single Grinders	30″x4″	Blount No. 7
1	Cold Saw, No. 6	4″	Cochrane-Bly
1	Cold Saw, No. 6	12″	Newton
1	Hot Saw and Burring Machine		Ajax
1	Steam Hammer	4500 Pounds	Massillon
1	Steam Hammer	2500 Pounds	Massillon
2	Steam Hammers	1500 Pounds	Massillon
1	Steam Hammer	1200 Pounds	Massillon
1	Steam Hammer	200 Pounds	Massillon
1	Air Hammer, Motor Driven	165 Pounds	Beche-Hazel
1	Bar Iron Shears		Oeking
1	Dbl. Punch and Shears	18″	Hillis & Jones
1	Forging Machine	5″	Ajax
1	Forging Machine	3″	Ajax
1	Forging Machine	2″	Ajax
1	Forging Machine	1½″	Ajax
12	Double Forges		McCaslin
1	Furnace	9′x14′	Ferguson
1	Furnace Case Hardening	28″x69″	Ferguson
1	No. 5 Furnace 5″ Forge Mach.		Ferguson
1	No. 4 Furnace 3″ Forge Mach.		Ferguson
1	No. 3 Furnace 2″ Forge Mach.		Ferguson
1	No. 3 Forge Mach.	1½″	Ferguson

Passenger Car Shops.

1	Knife Grinder	6 Whl.	Bridgeport
1	Auto. Planer Knife Grinder		Bridgeport
1	Grindstone	6′x36	Grabo
1	4-Side Planer		S. A. Woods No. 10
1	Planer and Matcher		S. A. Woods No. 404
1	Inside Moulder	12″	S. A. Woods No. 107
1	Outside Moulder	9″	S. A. Woods No. 129
2	Cut-Off Saws	36″	Greenlee
2	Comb Saw Tables		Am. W. W. Co. No. 2
2	Rip Saw Tables		Greenlee
1	Comb Saw and Dado		Am. W. W. Co. No. 8
2	Dbl. Cabinet Saws		Fay & Egan
1	Edging Saw, Power Feed		Fay & Egan
1	Edging Saw, Hand Feed		Fay & Egan
1	Swing Saw		Fay & Egan
1	Swing Saw		Am. W.W. Co. No. 75
1	Scroll Saw, Self-Contained		Bentel & Margedant
2	Band Saws	36″	Amer. 14-C
1	Vertical Tenoner		Greenlee 525
1	Car Sill Gainer		Greenlee 315
1	Tenoner and Gainer		Greenlee 536
1	Tenoning Machine—Pedestal		Greenlee 531
1	4-Spndl. Borer, Power Feed		Greenlee 329
1	4-Spndl. Borer, Hand Feed		Greenlee 329-H
1	4-Spndl. Borer, Hand Feed		Greenlee 329-H
1	Horiz. Borer, Single		American No. 2½
1	Vertical Mortiser		S. A. Woods
1	Endless Bed Surfacer		Am. Wood Work
1	Cabinet Surfacer	24″	B. O. Whitney
1	Paneling Machine		Fay & Egan No. 314
1	Double Shaper		Whitney
1	Stroke Vertical Mortiser	3½″	Fay & Egan
1	Chain Saw Mortiser		New Britain No. 2
1	Lathe, Pattern Maker's	26″x12′	Amer. 29-A
1	Dowelling Machine		Cowdry-Berlin
1	Sash Clamp		Greenlee No. 600
1	Triple Drum Sander	42″	Berlin No. 401
1	Dimension Planer	25″	Fay & Egan No. 32
1	Buzz Planer	16″x7′	Berlin No. 199

Car Blacksmith Shop.

1	Single Grinder	30″x4″	Blount No. 7
1	Steam Hammer	2000 Pounds	Massillon
2	Steam Hammers	200 Pounds	Massillon

No.	Machine.	Dimensions.	Make.
1	Board-Drop	1000 Pounds	Niles-Bement-Pond
1	Bar Iron Shears, No. 3		Hillis & Jones
2	Double Punch and Shears	18"	Cleveland
1	Forging Machine	5"	Ajax
1	Forging Machine	2"	Ajax
1	Eye Bolt Bender	1½"	Williams-White
1	Bulldozer	No. 9	Ajax
7	Double Forges		McCaslin
1	Furnace Bulldozer	No. 9	Ferguson
1	No. 5 Furnace 5" Forge Mach.		Ferguson
1	No. 3 Furnace 2" Forge Mach.		Ferguson
1	Eye Bolt Forge Mach.	1½"	Ferguson
1	Drop Hammer Furnace	36"x37"	Ferguson
	Tire Shop.		
1	Tire Furnace	84"	Ferguson
	Flue Shop.		
2	Flue Welding Furnaces		Ferguson

A BONUS SYSTEM FOR EFFICIENCY ENGINEERS.

John Archibald was an efficiency engineer—at least that is what he called himself. There is no question but that he was very efficient in making his presence known whenever he was around. He made a business of placing old-fashioned plants upon a basis where they could double their dividends—at least that is what he said he did, and on the strength of what he said about himself, he was called into consultation by the owners of the Smith & Brown Co., which has done a profitable business for the last twenty-five years.

One sunny morning Mr. Archibald appeared at the Smith & Brown plant and began taking notes of the very inefficient methods that they were using; and he was quite frank about letting them know that he could see opportunities for improvement right and left. He studied the conditions for a week or so and then he made his report, which was to the effect that he saw chances for decreasing costs to the extent of $40,000 or $45,000 a year. He also reported that this improvement could be made if he were hired as efficiency expert and given two assistants of ordinary training and intelligence. He further intimated that his services would be worth $5,000 a year and, as his assistants could be hired for very little money, a saving of at least $40,000 a year could be accomplished with an almost negligible initial expense. This report ought to have pleased the Smith & Brown Co., and it undoubtedly did, but the prospects of the coming prosperity somehow burst so suddenly upon the owners that they were unable to decide right away as to what to do. They agreed, however, to write to Mr. Archibald within a few days stating their intentions. In a few days Mr. Archibald received the following letter from Mr. J. P. Smith, the president of the Smith & Brown Co.:

Mr. John Archibald,

24 Blank Street, New York City.

Dear Sir: We have carefully considered your report regarding the possibilities for increased efficiency in our plant. We think, however, that the compensation which you expect for your services is entirely too modest and is not commensurate with the great saving that your knowledge and ability would accomplish in our plant. We therefore propose that instead of paying you a fixed salary of $5,000 a year, as stated in your memorandum, we share with you the entire resulting savings of the first year, after the system which you will install has been put into operation, you receiving one-half of this saving. We think that this arrangement will be entirely agreeable to you, and expect to hear from you at an early date. Yours very truly,

J. P. Smith, Pres.

It has always seemed very peculiar to Mr. Smith that he never heard from Mr. Archibald.—*Machinery.*

CASTINGS AND ECONOMY.

By B. H. Logan.

Doesn't the pattern storage room of a railway company always suggest waste? The first one I ever saw with great conglomerate heaps of patterns of all kinds started me to thinking and later experience with railway and car building companies has confirmed the suspicion that there was poor economy exercised in the use and design of castings.

Although a great deal of this waste could be saved, few companies have made any effort to do so. Few of the executives with whom I have come in contact seem to realize this extravagance or have attempted any systematic prevention of it. The whole trouble is simply lack of system.

In nearly all drafting rooms a casting is designed by any draftsman who finds he needs one to meet given conditions. Now, there are few offices where the man can go to an index which will enable him to determine easily and quickly whether or not there are patterns already in existence which can be used. Indeed it would take a very elaborate and ingenious system of indexing to meet such conditions, when so often details have different names at different places and the average draftsman is more or less a wanderer.

Very often a casting can be used for a purpose that its proper name would never suggest. For instance, I have seen a grab handle socket used for a wall brace on a vertical shaft. Only a man whose business it is to be thoroughly familiar with the patterns previously made would think of such a substitution.

Every large drafting room should have such a man. He could and should see to it that there is no duplication of patterns and that conditions are made to meet the castings already designed whenever it can be done economically.

Suppose our draftsman has been assured it is necessary to design a new casting; will we let him design it? Yes; he does in nearly all offices and he lays out the surfaces or faces, puts in the necessary holes and then adds bracing and stiffening webs as he has seen others do or as he has found used on similar castings. This man's previous experience may have been principally on wood or steel construction and the design of castings has always been of secondary importance. Few such men know the rudiments of foundry practice and cannot design castings with an eye to simplicity or ease in molding. They do not know the probable magnitude or direction of internal stress and therefore are not competent to estimate the strength of a given section or shape. I have seen men design castings who wouldn't know a malleable from a soft casting. These men are not ignorant. The trouble is few of them have any opportunity to study foundry practice or cast metal physics and chemistry and are certainly not to be blamed if they know very little of the principles or details of casting design. I saw a man who had occasion to use a push pole pocket change the drawing to give a half inch less depth to the pocket and thereby save a considerable sum of money. In fact, after redesigning the casting he saved $500 on one large order of cars. This saving was effected on a single casting which had been in use for years.

Let the man whose business it is to know the pattern stock design all castings and be sure he knows cast metal through and through. If one man can't actually do all this designing in a large office he can at least superintend it. He will live among his castings and will be familiar with them all. He will have his past experience to guide him in the design of new ones and can watch for all faults that will inevitably show up in molding at times. This man should also requisition all castings used.

My argument is simply for an expert in a work that is of enough importance in a great many plants to justify all the thought and study he can give it. The right man on the job will save money for the company that employs him.

SHOP OUTPUT.

By J. H. Tinker, S. M. P., C. & E. I. R. R.

About three years ago a mechanical official of another railway asked me how many pits we were operating in our shops and the number of engines that we were turning out per month. After giving him this information for our line, I asked him what they were doing, and as near as I can remember, he stated that they had turned out fifty-two engines from twenty-two pits. As this was almost three engines per pit, per month, and so many more than we were turning out, I could not understand it and made up my mind at that time to investigate how they accomplished this. A short time afterwards I had the opportunity of visiting this shop and in conversation with one of the gang foremen, he told me that they had turned out as many as forty-eight engines, and while this was quite a few less than the number that had previously been given me, it was still much more than we were accomplishing, and at the same time they had about as many men working on machines on stock material as we had on machines in our entire machine shop.

Suppose for instance, that a superintendent of motive power made such a statement to another superintendent of motive power who was not getting such an output, what would he do? He would naturally call upon his master mechanic or shop superintendent for an explanation as to why he could not do as well as his neighbor; he would probably be criticised and placed to a great deal of embarrassment, while in reality he might be getting 100% efficiency from his shop and men, and if a detailed comparison or some uniform method of showing output was adopted by these two roads, his output would, no doubt, be on a par with the shop with which the comparison was made. Ever since this occurrence I have felt that some uniform method should be adopted when comparing the output at one shop with another, as unless this is done a fair comparison cannot be made.

Shop efficiency or output must be based on some uniformity and a great number of things taken into consideration. I believe the following questions should be considered:

1. General lay-out of shops and machinery.
2. Number of men employed in all shops (average per pit).
3. Number of pits operated.
4. Average number of machines per pit.
5. Amount of finished stock material.
6. Facilities and method of handling.
7. Class of repairs.
8. Size or tractive power of locomotives.
9. Organization.
10. Piece work or day work.

Taking the majority of the above items for a basis to work from, I have prepared a statement showing the number of locomotives turned out of our shops at Danville, Illinois, for the years 1912 and 1913, taking into consideration only classes 1, 2 and 3 repairs:

In order to explain just what is meant by Class 1, 2 and 3 repairs, I am giving you below our classification:

1. New boiler or fire-box complete, new flues and general repairs to machinery.
2. Heavy repairs to machinery, flues reset, one-half side sheets, new front and back flue sheet, new crown or door sheet, tires new or turned.
3. Light repairs to machinery, flues new or reset, tires new or turned.
4. Covers all repairs not included in Classes 1, 2 and 3, where expenses for labor and material exceeds $125.00.

X. Covers accident repairs and may be used in connection with numbers 1, 2, 3 and 4, or separately when the repairs made include damaged parts only.

Any repairs made where the expenses for labor and material is less than $125.00 will be considered "Running Repairs."

New patches on side of flue sheet not considered in class 2 repairs; new extension front ends not considered class 2 repairs.

I have not taken into consideration class 4 repairs, yet we have turned out a number of this class of repairs where the cost would run $600.00 to $800.00 on account of the engine meeting with an accident immediately after receiving general repairs and could not be classified otherwise, not receiving new boiler, fire-box or flues. The average number of engines turned out of the shop for class 4 repairs is about eight per month.

In analyzing the above statement of output at the Oaklawn shops, you will note for the month of August, 1913, an increase over the corresponding month a year ago of twenty-five per cent (43% increase in tractive power) with only fourteen per cent increase in men employed, twenty-one percent in pits operated and thirty-seven per cent in engines per pit, with an increase of only a fraction of over three and one-half per cent in the shop pay-rolls. This increase in output has been accomplished by the methods as later explained.

I am under the impression that ten or twelve years ago the average number of days for an engine on the pit in the back shop was from fifteen to twenty, but the engines were much smaller and carried less steam pressure than at the present time. Now we have heavy Mikado engines and with the addition of heavy appliances, such as superheaters, etc., they will run from twenty to twenty-four days on the pit, as an average. Therefore, when you compare our output of 1.09 engines per pit for the month of August with the information that was given to me and as mentioned in the first part of this paper, which would amount to 2½ engines per pit, per month, the general impression would be that we were not getting efficiency from our shop, yet I believe with a more uniform system of comparison we would have nothing to be ashamed of.

I believe a shop schedule or counting system will increase efficiency. We have not tried it on our road other than to set a date that we anticipate the engine to be completed, painting this date on a board and hanging it on the engine, so that each foreman will know when the engine is expected to go out.

We specialize our work as much as possible. The shops also get out all finished parts, such as driving boxes, shoes and wedges, flues, etc., for all roundhouses on the system where we have no machines. All repair parts are furnished from Danville shops. Our back shop forces also handle repairs to all stationary boilers, pumps, air compressors, etc., on the system, as well as handle derrick cars, Lidgerwoods, steam shovels, gravel spreaders and center plows. In addition all tools and other machinery is sent to these shops for overhauling. We repair at Danville all jacks, air tools, etc., for the entire system, and in the statement shown above we have included all men employed, while if we deducted such employes as handle

MONTHLY EFFIENCY OF OAKLAWN SHOPS

MONTH AND YEAR	CLASS NUMBER OF REPAIRS 1	2	3	TOTAL	TRACTIVE POWER IN THOUSANDS OF POUNDS CLASS No OF REP. 1	2	3	TOTAL T.P. OUTPUT PER MONTH	No. OF MEN EMPLOYED	No. OF MEN PER 1000# T.P. OUTPUT	No. OF PITS OPERATED	No OF Eng. PER PIT OPERATED	No OF MEN PER PIT OPERATED	No OF MEN PER ENG. OUTPUT
JAN 1912	4	11	3	18	119	356	95	570	682	1.19	16	1.20	42.6	37.9
JAN. 1913	1	5	10	14	32	118	297	447	607	1.36	15	.93	40.4	43.3
FEB. 1912	6	9	7	22	189	304	200	693	699	1.01	15	1.46	46.6	31.8
FEB. 1913	2	9	6	17	50	332	197	569	622	1.09	15	1.13	41.4	36.6
MAR. 1912	4	10	4	18	108	324	109	541	550	1.02	13	1.38	42.3	30.6
MAR. 1913	1	8	8	17	25	206	281	602	602	1.00	14	1.21	43.0	35.4
APR. 1912	0	1	1	2	0	38	25	63	250	4.00	4	.50	62.5	125.0
APR. 1913	5	6	6	17	156	200	183	542	668	1.23	13	1.30	51.4	39.3
MAY 1912	0	1	4	5	0	15	125	140	265	1.90	4	1.25	66.1	53.0
MAY 1913	6	5	4	15	181	199	105	485	585	1.26	14	1.07	41.8	33.0
JUNE 1912	1	3	3	7	25	112	100	237	444	1.87	9	.77	49.3	63.4
JUNE 1913	7	4	9	18	251	149	300	700	620	0.88	16	1.12	38.8	34.4
JULY 1912	3	9	4	16	73	276	129	478	712	1.50	19	.84	37.5	44.5
JULY 1913	6	5	11	22	183	169	457	809	750	0.92	22	1.00	34.1	34.0
AUG 1912	7	8	5	20	206	283	188	687	713	1.03	19	1.05	37.5	35.6
AUG. 1913	6	11	8	25	191	409	383	983	819	0.83	23	1.09	35.6	32.7
SEP. 1912	4	6	2	12	125	183	76	384	696	1.60	14	.86	44.0	51.3
SEP. 1913	4	8	13	25	113	269	495	877	825	.94	23	1.09	35.9	33.0
OCT 1912	3	7	5	15	83	226	128	439	572	1.30	13	1.15	44.0	38.3
OCT 1913														
NOV. 1912	1	6	5	12	19	183	162	362	572	1.44	12	1.00	43.5	43.5
NOV. 1913														
DEC. 1912	6	5	7	18	149	193	200	526	566	1.07	13	1.38	43.5	31.4
DEC. 1913														

this special work, the number of men per pit would be considerably less than that shown.

Efficiency means a great deal more than eliminating lost motion. A man may become so mechanical (and in a good many instances due to specializing) that he is useless along other lines. The output of a shop depends greatly upon the system of handling, and most any system is good that cuts out lost motion or duplication of work, following the different parts through the various departments, etc. However, the conditions in one shop might be so different from another that a system adopted in the one would not be effective in the other.

I am giving you below a synopsis of the movement of an engine through our shops:

1. Engines are reported for the back shop by the division master mechanic for the class of repairs that they are in need of, class 1, 2, 3 or 4, and in addition to this a work report is furnished the superintendent of motive power, covering the general condition of the engine, such as cylinders and broken frames, and he in turn advises the date he is ready to accept the engine for repairs.

2. Engine arrives at shop; if under steam, fire is knocked out, cinders dumped and engine thoroughly blown off by air on the pit before taken in shop. All tools are removed and stenciled, to be replaced on the engine when repaired.

3. The tank is disconnected from the engine and sent to the power house, where the coal is unloaded and used for stationary purposes; when this has been done it is turned over to the tank shop for repairs.

4. Engine is thoroughly inspected and all missing, broken or worn out castings are reported to the shop superintendent, who in turn furnishes the store department material cards covering all the material that is needed to make these repairs. These cards designate on the face where this material is to be delivered, i. e., to what machine, etc. These cards are dropped in a box provided for this purpose, and are gathered up by the store department twice each day and the material is sent to the machine where it is to be finished, to avoid unnecessary handling.

5. Engine is taken in shop, where all work is stripped and placed outside of shop in front of pit. We have four gangs in machine shop of six pits each. The gang foreman is advised the class of repairs the engine is to receive, based on its general condition and the mileage it has made. The date engine is expected out is furnished all concerned.

6. Gang foreman notifies stripping gang, composed of two machinists and four helpers, the amount of stripping engine is to receive according to class of repairs; stripping gang raises and blocks all engines, cleans all work and delivers the different materials to the various shops or special benches where work is to be completed.

7. After engine has been placed on blocks the steam pipe gang removes front end, dome cap and stand pipe. Flues are removed and sent to flue cleaning shed to be repaired, boiler is thoroughly inspected for cracks and flue sheets examined.

8. All driving boxes delivered to special gang, where they are thoroughly inspected and repaired, re-brassed, planed and bored, ready for fitting to journals. All driving box work is handled in one end of shop, where the machinery for completing boxes is located, and boxes are passed along from one machine to another and finally completed. The gang foreman is notified that boxes are ready for fitting and mounting on wheels.

9. Links and all motion work is delivered to special link gang, where repairs are made complete ready for application to engine. Special machinery for this work is located near link gang.

10. All throttle rigging, steam pipes, steam-pipe joints, stand pipes and valves are taken to special steam pipe gang, where they are thoroughly ground and repaired ready for use.

11. Rods, pins, collars and brasses are all delivered to special rod gang located near the center of shop, which is surrounded by machinery adapted for repairing rods, to prevent too much handling and transfer work. This gang is provided with three air hoists (which cover their entire space) for handling the rods from one bench to another.

12. All wheels are thoroughly inspected, pins and journals are calipered to determine if they will finish to a special size below the original (which on axles is $\frac{3}{8}$" below original size, and crank pins $\frac{3}{16}$" below original). These wheels are then removed to the quartering machine, where they are tried for quarter and stroke; if pins are out of quarter and stroke, they are removed. If only out of round from wear, we have an attachment which we installed in the shop for turning all pins in the quartering machine. We, therefore, have our wheels in perfect quarter and in stroke. Rods are all bored to fit pins, worked out from blue print. After wheels are quartered they are removed to the journal turning machine, where all journals are tried for "true"; if not true they are turned and rolled. We do this work on an old wheel lathe converted into a journal turning lathe, by removing one face plate from the machine and using the other face plate for the driving pulley on the lathe, making a perfect driver and turning both journals at the same time, and then rolling both of them; we feel that our wheels come as near being perfect in quarter and stroke as it is possible to make them. The handling of these wheels is all done with our under-traveling crane, which places the wheels on the different machines.

13. After wheels and all material is removed from the engine, frames having been placed on blocks, they are thoroughly cleaned and then white-washed so that any crack in same may be detected.

14. Should the engine be in need of new fire-box, it is taken to the boiler shop, transfer being made by placing engine on transfer table and delivering to boiler shop. We then put on this same pit another engine for general repairs, to be out the same month.

15. All jacket work and pipe work is removed and delivered to the tin shop for renewal or repairs, each piece being stenciled or tagged, designating the engine to which it belongs.

16. All lagging is removed and put in bundles, properly tagged and taken to a shed for safe keeping, to be re-applied when needed. Old or broken pieces of lagging are put in a vat and steamed to a pulp and used again around flexible stay-bolt caps or places where a large piece cannot be used.

17. All cab trimming and injectors are removed and taken to a room where we have all the brass machines, to either make new or repair them, each piece being stenciled with the number of engine to which it belongs.

18. All steam gauges, governors, pops and air pumps are removed and placed in the air room, where they are repaired and tested; pumps are given a working test before being reapplied; pops are set by air pressure and gauge tested. In addition the safety valves are set to the proper pressure upon the boiler, in accordance with the Interstate Commerce Commission requirements.

19. Cab, runningboards and pilot are removed and delivered to cab department in the tank shop, where proper repairs are made and painted before returning.

20. Engine has now been in the shop a sufficient length of time to have such work as the jaws filed, spring rigging repaired, shoes and wedges laid off and boxes fit, and engine is ready to wheel. We raise the engine by electric crane, and the wheels are rolled under it and shoes, wedges and binders are replaced. In the meantime the flues are being put in the boiler, all cocks in cab, washout plugs and dome caps applied; all being replaced by the time that the flues have been reported ready for test. A boilermaker then inspects the fire-box and boiler in accordance with Interstate Commerce rules and pronouncing the boiler work O. K., the gang foreman orders the lagging, jacket and cab replaced, also all trimmings, injectors, etc. The rod foreman then applies the main rods so that the rollers can be placed under the engine for setting

the valves; after this is done the parallel rods are applied, and the painter foreman is notified that the engine is ready for painting. After being painted engine is removed from the back shop to the roundhouse, where the tank is applied, and the roundhouse foreman is notified that it is ready to be fired up for break-in trip.

21. The engine is turned over to the engine tamer, who gives it a thorough inspection and breaking-in and reports any defects or unfinished work to the shop superintendent, who has a special gang to look after this. Engine is then sent out on break-in trip and if any defects develop the shop superintendent is again notified and sends his force to make repairs. After these repairs are made the engine is turned over to the division to which it is assigned.

The output of a shop, of course, depends a great deal upon the organization. The operating conditions on our line (like a good many other railroads) the last six or seven years have been very disastrous to our shop organizations. We have been compelled to reduce our forces almost every year and in a great many cases have closed the shops entirely on account of depression in business, and every time this is done we lose the efficiency of the organization and some of the best mechanics in the country have left our shops on account of the fluctuation in working conditions. In opening up the shops again we have been compelled to hire almost any one that comes along representing himself to be a mechanic. A great number of these men only work a sufficient length of time to get a "stake" and we have experienced a condition that is hard on any kind of an organization, as we have found it necessary at times to hire on an average of twenty-five men a day at our Danville shops in order to keep our force of men at a given number.

Taking it for granted that a man is a good mechanic, I will venture to say that he will not develop 100% efficiency to the company until he has been in the service a certain length of time, say one or two months, as there will be conditions with which he is not familiar and it takes time to educate him.

In addition, mechanical departments have experienced in the past a great many delays on account of shortage of material. This is not a reflection on the stores department but due to the fact that retrenchments were necessary and they could not order material far enough in advance to prevent shortages when shops were again opened up.

It would be difficult for me to estimate the loss to any railroad company due to the fluctuation in working conditions but feel satisfied that if the conditions would permit working the shops uniformly the year around, the railroads would effect a great saving, and at the same time have the power in good condition, or comparatively so, all the time; in this way the mechanical department could figure on a certain number of engines falling due for the shop each month, whereas, during the past several years, the greater proportion of heavy locomotives have been put through the shops during the months of August, September, October, November and December, which you will appreciate in the regular order of events, make them all fall due about the same time the following year, and this is a condition that works hardships on the mechanical and operating departments. To illustrate this point: A railroad receives a lot of new locomotives in the month of November and under ordinary conditions these engines remain in service approximately fourteen months, necessitating shop attention about January, when, in all probability, there is the greatest demand for their service. The necessity of retrenchment curtailing the output of a shop in the summer months, prevents the repairs to other locomotives in the same class, making a shortage of power and congestion, which would make it inadvisable to shop these engines when due. To relieve a situation of this kind, it is occasionally necessary to advance the regular date of shopping to prepare the heaviest power for the service in winter months, and this necessarily increases the maintenance cost, also necessitates engines continuing in service longer than their condition would warrant, probably decreasing the miles run per failure, and unless these conditions are fully considered it is hard to get a fair comparison.

Again referring to the statement showing output: I do not wish to go on record as stating that this is the proper and best method to pursue in outlining shop output but I do wish to say that some uniform method should be adopted.

JOURNAL OIL BOX FOR PROLONGED LUBRICATION.

By. G. C. Cosmovici, chief engineer, material and traction, Romainian State Railroads, 28, Rue du Rocher, Paris.

On all railroads the rolling parts are made the object of particular care, which necessitates inspectors being placed at important stations to examine the trains passing. In spite of these precautions the most frequent accidents are just those caused by the oil-boxes getting warm and then over heating.

The constantly increasing speed of trains, and consequently the average increase in the number of miles each vehicle runs per annum, would not tend to remedy the frequence of these cases in over heating, if the engineers were not constantly endeavoring to improve the appliances for oiling the axle-journals.

One must also consider that the inspectors have no longer the necessary time to inspect all the boxes during the run, as the increase in the commercial speed of trains tends to reduce more and more the time of their stops in stations.

Then we must not forget that traffic-crises occur periodically and leave the shops almost no facilities for lifting the cars from their axles at the annual inspection of the rolling parts.

For the above reasons the box shown herewith should give unlimited lubrication, while avoiding loss of oil, thereby reducing the cost of upkeep, and necessitating only periodical examinations at still longer intervals than those actually customary.

The safety and economy of this box are manifest only when the oil with which it is filled is not only conserved as long as possible, but also remains clean and unspoiled. To attain this end, it was necessary to first reduce the apertures of the present boxes, thus preventing the oil from escaping, and at the same time to avoid the introduction of dust-particles during a run, which deteriorates the lubricating qualities of the oil and causes over heating. For this reason the box is made in one single piece, with a simple lid for filing, which form has already been adopted by several railroads.

Though this system was real progress, it did not exclude loss of oil on the side of the dust shield, losses easily proved by the oil projected onto the center of the wheels. Now, if the oil can escape, dust can enter by the back side of the box, finally clogging the lubricating wick, so that the diminished lubrication causes overheating in a very short time.

The box invented by G. C. Cosnovice shown herewith is hermetically closed at the front side by a cover (5), that is adapted on the journal, according to the drawing. The lubrication of the journal is not by means of wicks, but by a disc (6) turned by the axle.

The body of the box being open in front facilitates the introduction of the brass (10) and fastening block (9), and the steel disc insures lubrication. This arrangement permits of easily examining the journal.

The lower part of the box forms the oil-reservoir which is divided into four compartments: (1, 2, 3, 4). These compartments are not only inter-communicating among each other but also communicate with the box of the dust-shield at the back, by holes (19, 20, 21, 27) arranged at convenient height for the flow of the oil from one compartment into the other and its progressive passage to the compartment No. 4, before it is used for lubrication.

It is thus that the purpose of compartment No. 1 is to decant the oil containing dust-particles, which may have pene-

trated through the back of the box into the dust-shield cage; the compartments Nos. 2 and 3 facilitate the decanting of the oil which has served for lubricating the journal by means of holes made at the time of casting and arranged in the partitions of the box. The bottom of compartments Nos. 2, 3 and 4 is lower than that of compartment No. 1, to prevent the oil from being thrown out of the box. Compartment No. 3 is covered on top by the wall (35) inclined towards compartment No. 2, so as to prevent the oil that has already served for lubricating the journal, from falling directly into compartment No. 3, without having been decanted into No. 4, by the higher holes. In this manner the oil is forced to settle in compartment No. 3, which is provided with an opening (23) for emptying the dust sediment from the bottom of the box. The front vertical partition of compartment No. 4 terminates in a rib slanting towards the interior, so as to prevent the oil from touching the front joint of this box with its cover.

This succession of reservoirs forces the oil to follow a definite course and forms a series of obstacles.

The lubrication of the journal is effected by the disc (6) whirling through the oil. This system is frequently used in the construction of stationary engines, but heretofore has not been employed with satisfactory results in the lubrication of rolling material. The diameter of this disc is 10⅝" and its thickness at the edge ¼-inch. In the middle it has a hollow, the diameter of which is equal to that of the collar of the journal on which it is loosely mounted.

The disc is carried round by the journal in its rotating motion by means of two bolts (30), sliding freely in two cylindrical holes in the journal head. These bolts are screwed into the disc and kept in place by nuts and pins.

A play of .236 inches is allowed between the bottom of the disc and the collar of the axle, in order to allow the longitudinal movement of the axle in the box, the disc maintaining an unchangeable and well established position. In fact, in order to prevent the churning and deterioration of the oil, the disc is guided on one side by the rib (34) and the lower frame of the box; on the other side by the circular rib (32) of the cover.

The oil carried along by the disc in its rotary movement is stopped at the top by a special piece of bronze in the shape of U (25), sliding in two grooves made in a hole (24) drilled in the upper part of the box and closed by means of a hexagonal bolt and a leather washer. This bronze piece has on the side of the cover two projections (26) which lead the oil brought by the disc towards the channel (7) in the upper wall of the box. This channel then leads the oil into a cavity (8) arranged in the fastening wedge of the bearing, from where, through the hole (11, 12) piercing this wedge and bearing it reaches the friction surface of the journal.

After lubricating the journal, the oil is received in compartments Nos. 1 and 2, flows in compartment (3) and then passes into compartment (4) ready to be used again for lubricating.

The box is closed in front by a circular lid (5) turned on the lathe and fixed by bolts like on a cylinder-head. At the back the box is closed by two dust-guards, one of which is in linden wood (16) and the other (15) in cupped leather. The wooden guard is in two pieces held together by a spiral spring that presses them against the axle. The guard also has in the middle of its thickness a circular groove (17) communicating with a cut (18) in its lower part. The oil thrown upwards, reaching the leather guard, is obliged to fall back into the reservoir of the box; if a very small part of the oil has been able to pass under this guard it is caught in the circular groove of the wooden guard, and flows through the lower drip-passage to the lower and back part of the box, from where by the communicating hole (19) it passes back into compartment No. 1. Thus the oil cannot be lost, which has been fully proved in practice.

This box compared with those in use offers the following advantages, which have also been proved by experience:

1. Suppression of the loss of oil, the box being in one piece and without the leather longitudinal joint, existing between top and bottom of the ordinary boxes.
2. Permanent abundance of oil avoiding all heating.
3. Perfect tightness, as the oil is no longer thrown on to neighboring parts.
4. Important decrease in the amount of oil used, the same oil can be used three years without renewing.
5. Suppression of the inspection of oil boxes in the stations.
6. Methodical decantation of the lubricator.
7. No deterioration of the lubricating qualities of the oil.
8. Reduction of the friction co-efficient causing an unappreciable wear of the bearings and journals.

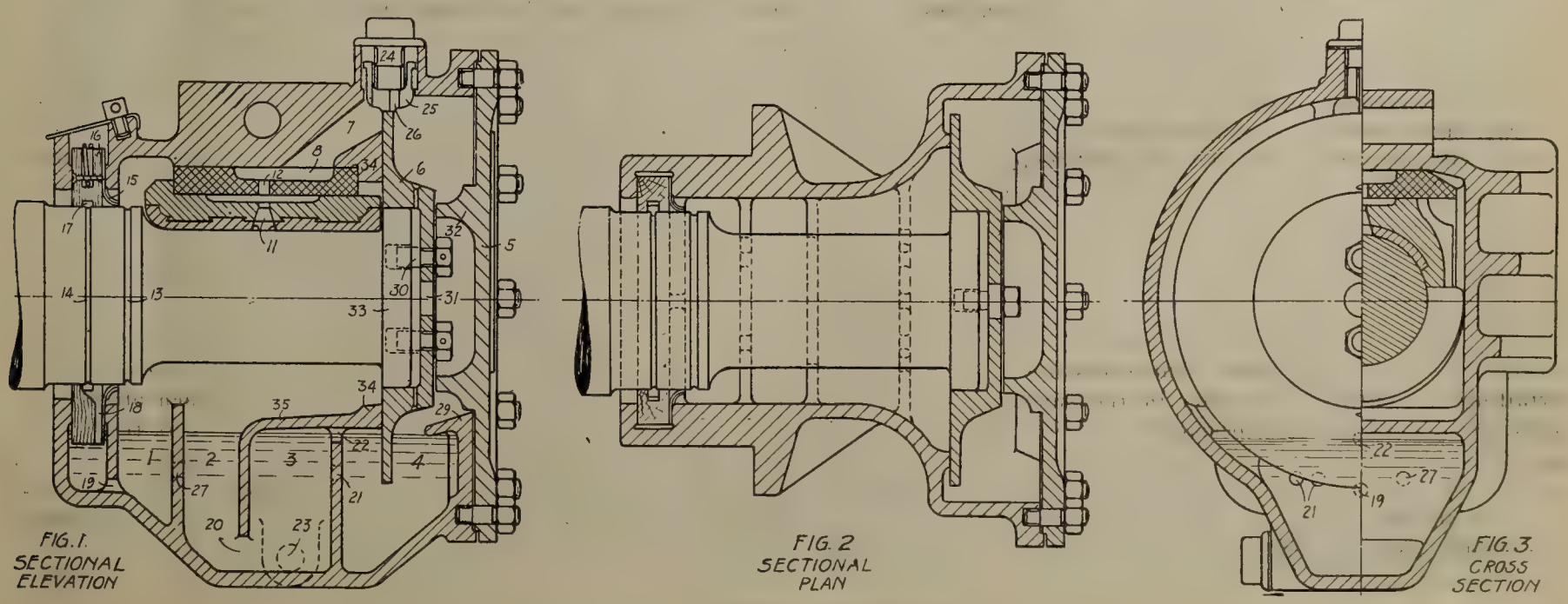
Results of Experiences

The first trial of the above described oil-box was made in Roumania on two axles of a third-class car equipped with Westinghouse brake. The type used was identically the one described above.

This car, thus prepared ran without interruption on the slow trains Nos. 177 and 178 Bucharest-Predeal, making a daily run of 178.3 miles from November 2, 1907, till the 12th of December, 1909, on which date it was withdrawn from service to be inspected.

During these two trial years the car had made 133,129 miles without counting the shunting in stations, and at the daily examinations not the slightest heating could be detected, nor was it necessary to add any quantity of oil during the whole period of the experiment.

At the examination a wear of only .01 inches was found on



Cosmovici Journal Box.

the journal and the bearings had only lost on an average of .105 pounds. The ascertained consumption of oil was at the end of two years of daily circulation, only 1102 pounds, for the entire quantity of 4187 pounds contained in each box. The oil remaining was a little thicker than when originally put in, but more unctuous, so that it could be used again. The oil used in this trial was the one currently in use for lubrica tion on the Roumanian railroads, coming from the second distillation of naphtha oils in Roumania.

The second experiment was made with a second-class car that was continually in service from July 22, 1908, till September 15, 1909, making in this period 101,051 miles, without counting the shunting in the stations.

At the inspection in the shops of Bucharest, after the trial, it was found that the bearings and journals were in perfect condition, that the wear on the journals was only .007" and that the bearings had lost on an average only .0132 pounds. The consumption of oil per box was only .88 pounds.

A third more conclusive trial was made with a train of 10 cars forming the express Bucharest-Galatz from November 25, 1908, till June 1, 1909, running daily 161.49 miles.

From this date until November 25, 1909, the trials were continued with the same cars as the express Bucharest-Iassy, with a daily run of 253.21 miles. After a year these cars were sent to the workshops for repairs to the interior and to the springs, the bands of which were worn out and some even broken.

On examining the boxes which had run 75,185 miles, it was found, especially on the cars, that the springbands which were broken, because of the unequal distribution of weight on the journals, that only some bearings and their journals showed blue marks, indicating a beginning of over heating. Nevertheless, as the lubrication was abundant the journal had cooled off again in time. Thus, the bearing and the journal had not suffered, the wear on the box was normal and comparable to that found on the other boxes of the same series of cars, namely, about .039". The bearings had lost on an average, .0132 pounds each. The consumption of oil per box had been .88 pounds. The exterior of the boxes and the neighboring parts had not the slightest oil-stains.

In consequence of these very favorable results, the board of directors of the Roumanian Railroads decided, in 1909, to provide all trucks and cars newly ordered with Cosmovici boxes, and to generalize their use from 1911 on. At present about 15,000 of these boxes are in use on cars having a capacity of 10, 15 and 20 tons and on fifty freight cars having a capacity of 50 tons each.

ILLINOIS CENTRAL BOX CARS.

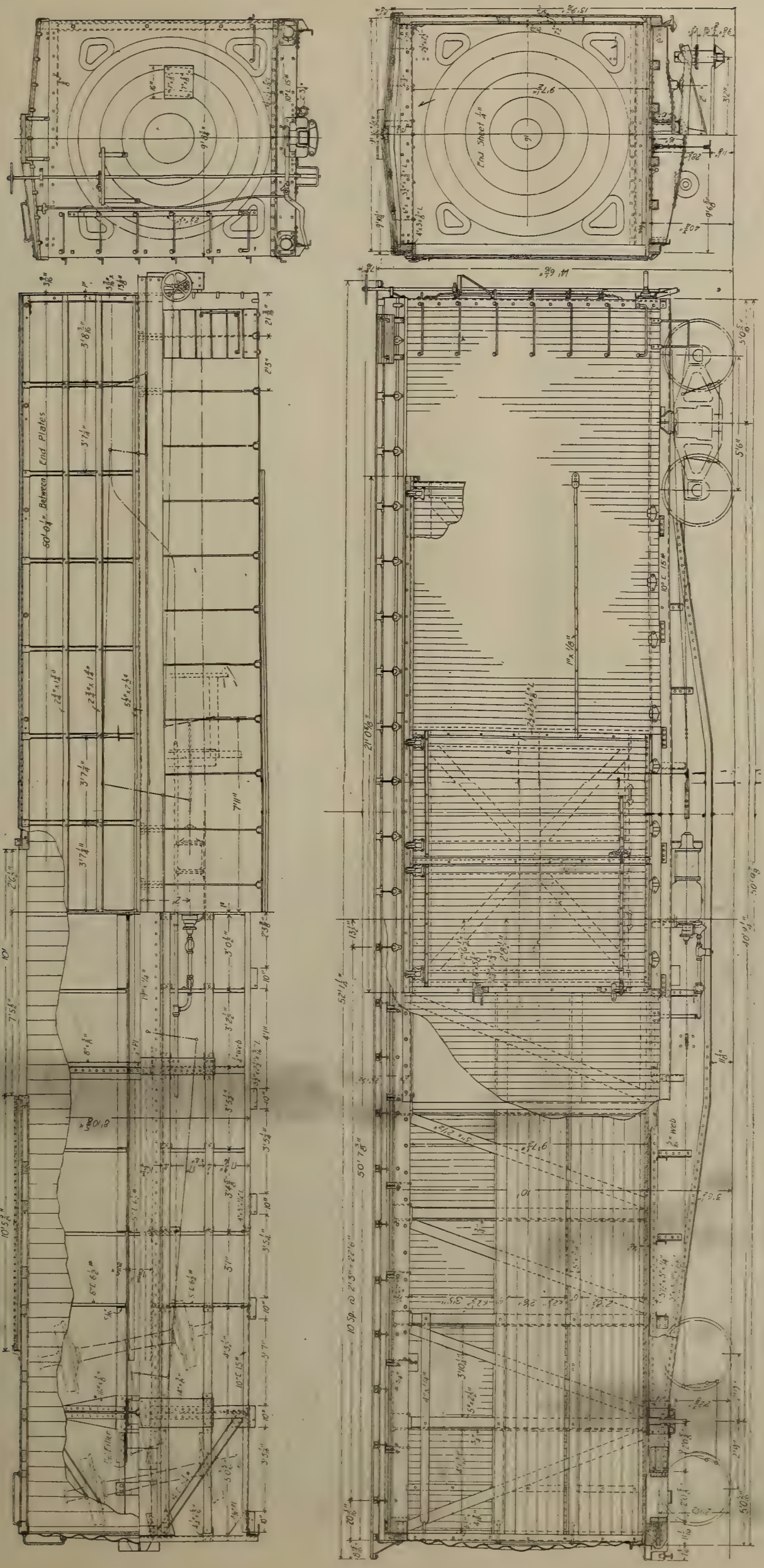
A large order of box cars comprising 300 fifty foot furniture cars and 500 forty foot automobile cars has recently been received by the Illinois Central Railroad. Both classes are of 40 tons capacity and were turned out at the Madison, Ill. plant of the American Car & Foundry Co. Although the upper framing is of wood, the cars are equipped with steel underframes and with reinforced or steel ends, providing a strong construction.

The furniture cars have a length inside in the clear of 50'-0¼" and a width of 9'-0", the height to the bottom of the carline being 10'-0". The steel side sills are continuous between end sills and consist of 10" fifteen pound channels. The center sills extend beyond the body bolsters and are riveted to the draft arms. They are of the fish belly type, 28½" deep over angles at the center with a steel cover plate $\frac{5}{16}$"x 19" riveted to the top angle of the sill. Web plates are also of $\frac{5}{16}$" steel. Draft sills are attached to end sills by steel gussets riveted to each member. The end sills consist of 10" fifteen pound channels applied to the car without bowing and are flanged outward. Cross bearers are of the built-up design, 16" deep at the center sills and of ¼" pressed steel. Floor supports are 5" six and a half pound steel channels. The draft arms are of pressed structural steel, spaced 12⅞" between webs, with the unflanged side toward the center of the car. They have a wrecking chain bracket above the draft gear for inserting a wrecking chain.

Bolsters are of the built up type, 9¾" deep between cover plates and consist of ¼" pressed steel shapes. The side bearings are of the roller type and riveted to the bolster. The king pin is 2" in diameter and fitted with a key. The Miner draft rigging with a cast steel yoke is used and the centering device is the Imperial. The couplers are of the Sharon cast steel type, with 5"x7" shank, the coupler yoke being that of the Buckeye Steel Castings Co.

The side posts and braces are of wood, fitted at the top

New Freight Cars for the Illinois Central, Showing Van Dorn Steel End.



Plan, Elevation and End Views of 50 Foot Illinois Central Furniture Cars.

and bottom to malleable iron pockets. There are fourteen 5"x2½"x9'-7½" side posts of yellow pine and four door posts of white oak, 5"x5⅛"x9'-7½". The carlines were supplied by the Standard Equipment Co., there being thirteen spaced on about four foot centers.

A notable feature of these furniture cars is the application of Van Dorn one piece steel ends, affording as they do added protection at the point where the greatest amount of damage occurs on cars. In addition to their strength they add to the appearance of the car as the illustration shows. The roof is the Murphy XLA. The side door opening is 10 feet. The cars are equipped with New York air brakes, Bettendorf cast steel side frames and Simplex bolster.

The automobile cars are similar in general construction to the furniture cars. These cars have a length inside in the clear of 40'-1$\frac{1}{16}$", a width inside of 9'-0" and a height of 10'-0". One end of the car can be opened by double end doors and the other end is reinforced by 2 U-shaped steel bands across the end of the car.

THE APPRENTICE QUESTION.

By H. E. Blackburn, Instructor of Apprentices, Erie R. R.

If we are to believe the report as offered in Volume 7 of the Sixty-first Congress on why boys leave school, the State of Pennsylvania has a compulsory education law that is very poorly enforced. The report states that for every one hundred boys who enter the primary grades, fifty-five leave before they reach the last grammar grade, and that only four of the one hundred who started, graduate.

In other words, more than one-half of the boys leave school before they receive enough education to fit themselves out for a common school education of the "three R" kind.

The report also blames the parents for their indifference in the matter, as they often handicap the truant officer in his work of recruiting boys for the school.

The *Lackawanna Bell* for October states that the apprentice instructor examined 694 boys around the age of sixteen, for trade apprentices, and that only 340 boys were able to work above common fractions.

The Erie Railway is having the same trouble in recruiting boys from the public schools, and taxpayers are wondering why the school tax is going up and the efficiency of the school is going down. There is certainly something wrong, in helping the boy out to follow vocational work, and if they do not teach this branch of work, it is time to take the children who were born to work out of the schools and place them where they will learn something they can use later on.

The city of Scranton boasts of one of the greatest schools in the United States, the International Correspondence School; a school that seems to teach in every city but its own. Here there is also a free technical night school of the first order, fully equipped to teach practical work, and still you find boys trying to learn to be mechanical engineers by surveying the street corners every night. Such boys do not seem to realize that beaten paths lead to overcrowded places and discarded opportunities, and that if he is to be a man of some account in the world, he must tackle work with an education back of his muscle, energy and ambition.

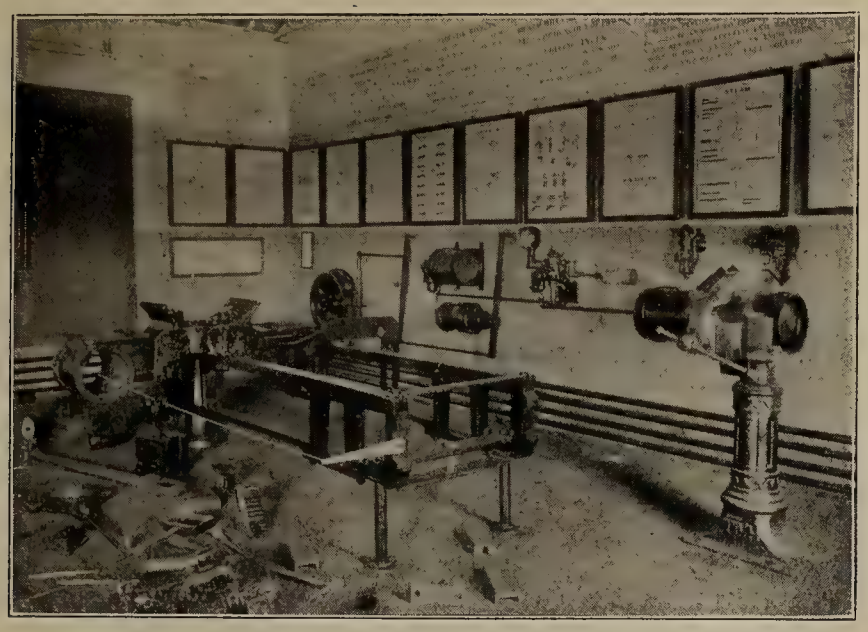
The majority of the boys who fail to pass the prescribed shop course examinations (if one is to be governed by their size) appear to have had their minds on frequent and regular meals more than on school work.

Many of these boys were introduced to the instructor by shop employes as "like father, like son," and, supposedly, good material, while really what the old man wanted was to get the boy off the street.

There is also another kind of a boy that has dodged the school bell for several terms, namely, the widow's son. This boy is always forced on the instructor as a charity patient, so as to help his mother along in her declining years, and you sit still a long while wondering how the two will live on eight cents per hour with the cost of living still going up.

Occasionally you will have one of these boys pushed into the shop, and while you know he is only fit for the blueing works, you can only keep on telling him where the gate is,

Using Stereopticon at Dunmore to Show How One of the Apprentice Boys Does the Work Correctly.



Locomotive and Air Brake Model With Charts.

until for relief he finally asks for a job on the milling machine, the most lonesome variety of machine to be found in the average shop. After he has decided to put in a few extra nicks in the work, also the table, he consults the foreman (who by this time does not like the boy on general principles). Of course, the foreman admires the boy's artistic work, but upon consulting the print he becomes displeased, perhaps abusive, and if the boy is not fired, he is put to tapping nuts.

There is little use trying to teach an uninterested boy the what, how, and why of the trade, especially if you have some fifty-seven or more boys who are willing to sit up and listen. The rule of "more rejoicing over one sinner saved" does not work out in the apprentice classroom, when you only have, say four hours per week, with fifty-seven varieties of boys to show them the ins and outs of the trade.

The instructor finally believes that the old saying is true, that mechanics, as well as artists, are born and not made; and, to quote Shakespeare, it is more in the picking than in the making, whatever that is.

The question of vocational training is being talked of as a part of the public school course, for those who are found out to have aptitude towards the trades. This is a most proper course, for in this way the boy may select for himself his life work.

If there was less history and more shop arithmetic taught in the schools, boys would see where the figures come into use as a means of living later on, employes would get better help, parents better wages for their boys, and there would be happier homes for all later on.

Of course, everyone is not supposed to lean towards the trades, and the public school takes care of those who don't take to the trades. If it does not, the high school and college put on the finishing touches. However, it takes money to follow these courses, and there are college men now who have a good eye and a steady aim who are going around shooting blank cartridges and never bagging any game, just because they have not had enough practical experience.

Every apprentice instructor who has had any shop experience knows that to get any results from the boys, the instructor must be well acquainted with each boy, both in and out of the shop, and that the only place to teach a boy the trade properly is in the shop, on the actual output work.

The writer has closely watched the apprentice boy question since piece work entered the shop, and has studied the best conditions for the boy, and as a suggestion would offer the following solution:

Build a small shop instead of a schoolhouse; equip this shop with machines (not junk) and benches, so as to be able to handle regular running work, of the light class, in the shop. Place the boys entering to learn the trade in this shop under a practical instructor. Give the boys fifteen cents per hour the first year, and start them out on piece work (if it is a piece-work shop) as soon as they can do the work properly on a day work scale. If you work the boys full time, they should finish their time in two years. The writer bases his experience on the number of good mechanics that the foremen have made out of fifteen-cent helpers—mechanics who are stickers, too. If the foremen can make a few mechanics in their spare time, why not take one of these foremen and make him an instructor, so that he can keep the good work up? It appears to the writer that the company would be in dollars and cents, if mechanics are wanted, for you can get "some man" and "less kid" for fifteen cents per hour. If draftsmen are wanted along with the mechanics, there is always about one out of five boys who just fit in here.

The illustrations give an idea of conditions governing apprentice instruction at the school of the Erie Railroad at the Dunmore, Pa., shops.

MAN-AFRAID-OF-HIS-JOB

During a recent jaunt into the wilds I ran across my old Indian guide, Charley, known to his tribe as "The-Man-Who-Pushes-the-Wind." He was sitting on the sunny side of a rock with a bottle of fire-water tilted at an acute angle with his long nose. He greeted me with his characteristic grunt. I essayed to fix him with a penetrating glance, but fear I missed scoring. "Aren't you afraid, Charley," I said severely, "that you will lose your job if you monkey with fire-water that way?"

"Me 'fraid? Charley 'fraid? The-Man-Who-Pushes-the-Wind 'fraid? Ugh! Me good guide? Me always on dot? Me 'fraid of job? Ugh! White man Man-'Fraid-of-Job; Indian 'fraid of nothing. Ugh." This was punctuated with another gurgle of fire-water.

Come to think of it, I never met an Indian who was afraid of his job, and I have spent a good deal of time among them. But I have met many a white man who acted as though he were. I wonder if Charley was right and that the paleface alone is entitled to be dubbed "Man-Afraid-of-His-Job?"

I will grant at the outset that a certain wholesome regard for your job is essential to the proper performance of its demands and duties, but it should be a subconscious rather than a conscious regard. The man I have in mind is afraid of his job—afraid of losing it—all the time, and this fear keeps him from filling any place he happens to occupy as it should be filled.

The man who is afraid of his job shows this fear in various ways. He is jealous of those who happen to be a rung or two below him on the ladder, because he fears they will overtake him, pass him, or jostle him off. He is envious of those above him because he cannot advance until they do and he does not possess the qualifications necessary to enable him to climb past them.

This jealousy and envy make of him one of the shop or office gossips. He is an industrious retailer of the petty little things that are said by members of his clan about those who are too busy doing all they should do to talk evil of their fellows. It tickles him to death to hear—whether it be true or not matters not a whit—that some one below him has slipped off his rung and is hanging by the skin of his teeth. He goes wild with ecstasy when some one above falls past him, and he cranes his neck to hear the thud with which the unfortunate hits mother earth.

And straightway he leaves his bench or his desk and hastens to spread the joyful news that there is less pressure from below him or less resistance from above. And while he gossips another energetic soul mounts from below or some one slips into the vacant place above—the place he might have secured had he not been afraid of his job.

In all the range of human activities there is no man so insistent on his little rights, so punctilius in demanding that his petty dignity be recognized, as the man who is afraid of

his job. Fail but for once to give him his full title, to accord him the proper salaam, to tip your hat at the right angle, and he will spend an hour of his employer's time in "showing you your place," and incidentally what he fancies his own to be. He is never so busy as when "calling down" some one who has seemed for the moment to forget that his supreme highness is on earth.

Let a rumor start about the shop or the office of some proposed change, and the man afraid of his job is rendered temporarily useless—that is, a trifle more useless than he usually is. He cannot work in the day for wondering whether the change will affect him, he cannot sleep at night for fear that it will. His ear and his eye are so strained to catch the least bit of chatter about the proposition that he neglects his work. And when the change does come, this neglect counts against him in the rearrangement of the force.

The man afraid of his job always wants to let the boss know what he is doing. In subtle ways for which often it is hard to reprove him, he passes his immediate chief or goes out of the accepted routine, to let the boss know that he is "some pumpkins." Of course this pleases his immediate chief, when he finds it out. The foreman always likes to have a proposition from one of his men come with the approval of the superintendent. It makes the foreman feel good to know that he has had nothing to say about something for which he will be held responsible. Thus the foreman generally has a deep affection for the man so afraid of his job that he has to trot after the boss.

Another and quite common way the man afraid of his job shows his fear is in trying to keep all the details of his work "under his own hat." You never hear of such a fellow having an "understudy," or at least genuinely trying to make an understudy capable and efficient to take his place. He is so afraid some one will know as much as himself that he plays a good imitation of the Sphinx when anyone under him asks for information.

Show me the shop or office gossip—show me the man who is ready at any moment to neglect his work to listen to or to spread some unpleasant word about a fellow worker—and I will show you a man so mortally afraid of losing his job that he is a burden to himself and a nuisance to others.

The surest way to lose your job is to be afraid of losing it. The surest way to hold it is to fill your place so fully, so capably, that you leave no room for fear, have no time for idle and petty gossip. Never be afraid to tell all you know about your work to those coming along the way you have traveled, and always find time to study the work of the man above you. In this way you prepare yourself for advancement when the opportunity comes, and you insure the proper performance of your present duties by helping some one to understand them.

The man at the top today is the man who always worked a little above himself. No sooner did he gain a step upward than he began to study the man on the next higher step. He was always a little better than the position he chanced to be filling, always ready for the next upward step when the chance came to take it. He never was afraid of his job in his life, never was jealous of those beneath him or envious of those above. He was a man in every way you took him, generous, kindly, just, charitable, capable, alert and courteous.

In which classification are you? Are you afraid of your job? Do you gossip about your fellow workmen? Does it make you feel sick to have some one neglect to give you your proper title? Are you wondering what may happen to you if some change in management occurs? Or are you like the man at the top, afraid of nothing but not doing your work as well as it can be done, afraid of no one knowing all you know, too busy for scandal, gossip, fault-finding, criticism, gadding about, too manly to shadow the boss's footsteps, too generous to take delight in the missteps of your fellows? I trust you are in this latter class, this efficient class, this class out of which must be graduated all our managers, superintendents, secretaries, presidents and other high officials.

If you have been the man afraid of his job, banish this fear now and start over. It is not too late, and you must do it if you ever expect to fill your present place efficiently or to advance to a higher place.—*The Valve World.*

HEAVY LOADING OF CARS.

One of the most important problems for both the railroads and the shipping public to solve today is the question of greater car efficiency.

In this connection the following indicates to what extent the United States Steel Corporation's constituent companies have been instrumental in creating a car supply during the year 1912 by increasing the average carload from thirty-four to thirty-six tons.

A comparative statement of the average carload of outbound traffic for the years 1911 and 1912 for the American Bridge Company, American Sheet and Tin Plate Company, American Steel and Wire Company, Carnegie Steel Company, H. C. Frick Coke Company, Illinois Steel Company, National Tube Company, Pittsburgh Steamship Company, Tennessee Coal, Iron & Railroad Company and Universal Portland Cement Company produces the following result:

During the year 1911 the average carload was 34.6 tons and for the year 1912 the average carload was 36.2, or an increase of 1.6 tons per carload. This increase of 3,200 pounds to the average carload on outbound shipments means there were 76,105 fewer cars used to handle an equal tonnage as compared with the average carload of the year 1911, based on the outbound traffic of the above ten companies.

Both the shippers and the railroads have been benefited to almost an immeasurable extent in the switching and weighing avoided, i. e., the great saving in operating expenses; switching service on 76,105 cars or 152,210 terminal movements, and the expense of handling this additional number of both empties and loads through the various classification or interchange yards of the railroads from point of shipment to destination. It proves conclusively the money value of conserving the freight car equipment, not only when there is a severe car famine, but at all times.

To illustrate: One company saved 122 cars by loading only 100 pounds heavier per car during the year 1912. The record of another company emphasizes the importance of heavier loading perhaps more than any other example, for even with only 400 pounds per car increase on its traffic means that 15,836 fewer cars were required to move the same tonnage.

Consider what the shippers of the Pittsburgh district generally could accomplish in the way of creating a car supply by increasing the average load per car. Based on the total Pittsburgh district tonnage for the year 1912, an increase in the average carload on approximately the same basis as the record made by the United States Steel, of two tons per car, would have resulted in the same tonnage moving in 409,524 fewer cars.

These figures not only indicate the large number of cars that would be available for shippers, but based on an average haul of 100 miles, the increase of 1.6 tons per car would decrease the car mileage 40,952,400 car miles.

While the Pittsburgh district tonnage is merely used as a basis for computation, there can be no question but what even a more remarkable showing could be made in increasing the average carload throughout the country generally, if the railroads would bring this subject before the shipping public. Shippers and consignees will be convinced that it is to their best interests to go to additional expense, if necessary, both in loading and unloading heavier cars, when they are made to realize that it means increased car supply, for there is nothing that interferes more with the general business of the country than a shortage of cars.

SAFETY FIRST IN THE BOILER SHOP.

By C. E. Lester.

The "Safety First" campaign inaugurated a few years ago on a leading railroad has received a great impetus of late, and is becoming more or less general on railroads and in industrial plants throughout the country. Employers are recognizing the very apparent fact that it pays, in divers way, not only to protect the public but to protect employees as well.

The movement is primarily one of education and is for the purpose of making every man a "Safety First" man. The campaign of education, by means of instructive literature, safety committees, lectures and moving pictures, delineating dangerous practices and showing wherever many such practices can be eliminated, or can be done in a safer manner, is increasing employers' assets and reducing their liabilities by having a more careful set of employees.

Employees and their families, as well as the general public, are benefited in the reduction in the number of deaths and permanent injuries to the bread winners. Many accidents that could be avoided by a little care are the means of reducing many a man's earning capacity, often bringing poverty to the the public at large.

"Familiarity breeds contempt." This old axiom is especially adaptable to industrial plants where men flirt with death repeatedly in a day's toil by carelessly performing tasks where family dependent, making them public charges and burdens to a great amount of danger could be eliminated by the exercise of a little more care. The "Safety First" movement is teaching men to see the danger they have become oblivious to by daily contact.

The origin of the term or the exact beginning of the movement is not known to the writer, but to give "credit to whom credit is due" it would appear that to the boiler designer of the past belongs a major share of the credit, for in no field of mechanical endeavor is there such a margin of safety provided as in boiler construction. The term "factor of safety" is undoubtedly father to "Safety First," and the whole boiler industry is based on a factor of safety.

The first thing considered in the design and construction of a boiler is the factor of safety, for on it depends entirely the thickness of the plate, the size and pitch of the rivets, the location and design of the bracing, and, in fact, anything and everything that affects in any way the strength of the boiler.

It is now a lawful requirement in most civilized communities that all boilers constructed or used shall have a certain factor of safety. The exact factor varies slightly in various states, provinces, etc. In some it is as low as 4 and runs as high as 6½. A factor of 5 is a fair margin of safety and is extensively used. To the uninitiated it may be said that a factor of safety in boiler work means the difference between the allowable working pressure and the ultimate or breaking strength.

For example: calculating the efficiency of the joints, strength of braces and tensile strength of materials, it is found that the weakest portion will burst when the steam pressure reaches 1,000 pounds per square inch. With a factor of safety of 5, or, in other words, one-fifth the ultimate strength, the allowable working pressure would be 200 pounds pressure per square inch; a factor of safety of 4 would give one-fourth; a factor of 6 would be one-sixth, etc., etc.

The factor of safety used in construction does not, however, prevail after an air or steam receptacle ages, unless the allowable working pressure is reduced from time to time to keep pace with the deterioration of the boiler. In the life of a boiler, particularly locomotive boilers, there are many causes that lead to the weakening of the different parts.

In construction, the forming of the plates changes the structure of the material, frequently weakening it. In service there is a practically constant expansion and contraction caused by a variation in the amount of heat supplied by the fuel on account of the effect of the grades, stops, slow orders, etc., and the injection of cold water, and also by climate changes in a few miles' travel.

At times when the boilers are washed out and the water let out for other purposes, and the boilers are filled and fired rapidly, enormous strains are set up by the materials trying to adjust themselves to the varying temperatures. The frequent recurrence of these conditions cracks plates, loosens seams, breaks staybolts and braces and otherwise impairs the efficiency of the boiler.

Impure water is a prolific cause of boiler trouble, causing foaming, priming, pitting, grooving and incrustation. The regulation of the water supply is, of course, out of the boiler foreman's or inspector's domain, but the defect brought about by these conditions calls for a careful and minute inspection at all times, especially in bad-water territory.

At the internal inspection time, the seams and joints should be made absolutely clean if there is any doubt about the seams' efficiency, and a few rivets should be removed to locate possible defects. Remember that "Safety First" is the slogan, and that missing a small crack at inspection time might result in a bad boiler explosion. A boiler inspection should be most thorough at all times and improper repairs not tolerated. The plugging of cracks in unstayed surfaces should be absolutely prohibited. It is common custom to allow plugging a flat surface up to six times the thickness of the plate. This practice, the writer believes, is not a good one to follow in plugging locomotive fireboxes, and he believes that any plug greater than 1 inch in diameter should be applied from the water side with a tapered thread or tied to the outer sheet with a staybolt.

In patching boiler shells care should be exercised in the design of the patch. Under no circumstances should the repairs reduce the efficiency of the boiler unless the pressure is reduced accordingly. In bracing boilers see that each brace is taut and bearing its own share of the load.

Once the head is off a flue there is nothing left to hold it in the sheet but the grip of the expanders. A lowering of the firebox temperature causes the flue to contract, and it immediately becomes a source of danger. Arch tubes and water bars cannot be too closely inspected. A little neglect on the part of the boiler washer to keep them free from scale or other obstructions may cause one to blow out and take a fireman's life.

The use of pneumatic tools as a part of shop equipment and air brakes on locomotives has necessitated the use of air storage reservoirs. These, being under high pressure, are as dangerous as a steam receptacle unless they are constructed with proper regard for safety and are well maintained. The practice of constructing shop air reservoirs from old locomotive shells and air-brake drums is one that should be discouraged if not prohibited. The writer has personal knowledge of three lives lost through one such reconstructed drum bursting, and of another one bursting without any loss of life. Each of these cases was entirely due to excessive pressure on a worn-out drum. It is but a few weeks ago that a workman had a hand blown off while testing an old drum to which he had applied a soft patch, because the shell was not heavy enough to take a patch-bolt thread. This was a clean case of carelessness or of incompetency on the part of the foreman.

Shop reservoirs should be constructed with the same factor of safety as a boiler shell. The heads should, preferably, be dished—one concave and one convex—and the reservoir set vertical with a drain cock at the very lowest point. They should also be equipped with a manhole, safety valves and pressure gage. Each reservoir should be given a hydrostatic test at least yearly, and at this time the safety valves and pressure gage should be carefully tested and the reservoir be given an internal and external inspection. Each reservoir should be plainly stenciled, giving the assigned shop number, pressure and date when the next test is due. Locomotive air reservoirs should be given a hydrostatic test each time the locomotive is given an overhauling and a hammer test at each boiler washing. Some inspectors seem to fear punching a hole

in a drum with a hammer pean when making a test. If it can be done it is just what should be done.

The "Safety First" ideas should not, however, be confined to the big things in the shop, as there are divers ways in which the safety of the workmen may be enhanced. The handling of heavy plates and boilers is usually given but little consideration; that is, as regards a safe manner of handling. The ordinary workman does not as a rule pay much attention to the size of a chain or the manner in which a boiler might be hoisted and turned in a safe manner.

The writer has in mind a plant where this particular kind of work has been carefully considered, the management full realizing the opportunities for accidents. Blue prints with sketches, showing the safest way to lift a plate by one or both edges, handling flanging blocks, lifting and turning boilers with the traveling crane and the several movements necessary to place or remove a boiler from the bull riveter, and, in fact, fully two score safe methods of doing this hazardous work have been framed and placed in the most conspicuous places in the shop. In watching this work to a considerable degree, it was noted in a period of time covering about three weeks that but once was there any attempt to deviate from the printed instructions, and in this case by a man new in the plant.

The inspection and care of chains and slings in plants of any magnitude should be detailed to responsible persons, and they held strictly accountable for their condition. In smaller plants the department foremen should be instructed to follow this work. Chains, slings and hooks should be inspected before being placed into service and at frequent intervals thereafter, and should be annealed at least every six months. The cooling after annealing should take at least ten hours. They should be minutely inspected after annealing and thoroughly lubricated with oil or grease to lessen friction before being placed in service.

It is often found that a careless smith will put in a link of smaller diameter than the original chain. This serious defect would scarcely be noticed in a long chain unless someone was looking for defects. Each chain or sling should have an identification number on the first link, and an office record kept of (a) description; (b) location; (c) date of inspection and annealing; (d) date of test.

Whenever the strength of any chain or sling is questioned, the entire part should be given a test load to determine its efficiency. The following table has been given by an authority on the subject as a safe and reliable one to follow:

Diameter of Rod Composing Link Inches	Safe Load for Chain Pounds	Proof Test Pounds
9/16	6,300	11,000
5/8	8,000	14,000
3/4	12,200	20,000
7/8	16,100	26,000
1	20,500	33,750
1 1/8	25,500	41,500
1 1/4	31,200	52,000
1 3/8	36,100	60,000
1 1/2	43,400	70,400

Specifications of chain iron should be as follows: Tensile strength, 50,000 pounds per square inch; elongation, 25 per cent; reduction of area, 40 per cent.

It is good policy to have the capacity of chains and slings printed and posted in the shop that the workmen may familiarize themselves with the same. Inasmuch as a large number of men now employed are foreigners, and speak but little English, it is a good plan to have the instructions printed in Italian, Polish, Slavish, etc., for the benefit of those who do not read English.

There are many, many ways in a day's work in the boiler shop that the safety of oneself and others may be enhanced. All moving parts of machinery should be guarded where possible; that is, gear wheels, flywheels, pulleys, etc., that are near the floor or where a person could accidentally come in contact with them.

It is interesting to note that in many different industries those in authority are making a study of the "Safety First" problem, and in many cases going so far as to order the dismissal of employees who insist on disobeying or not following instructions laid down for safety.

A report from the American steel foundries says: "Should workmen be compelled to wear safety goggles?"

"The employer, knowing the risks of accidents to eyes of his employees, is under a moral obligation to them and to the State to take positive steps to safeguard their eyes. The fact that the employee, because of a grievance or foolhardiness, may try to evade the use of the protection afforded, does not relieve the employer of this moral obligation. The obligation of the employer, together with the natural incentive to protect his own interests, and also reduce to a minimum the cost of his liability for compensation for injuries to his employees, should cause the employer to make eye protection his settled policy.

"The question is often asked, 'How can workmen be induced to wear safety spectacles?' The answer is: start an educational campaign at the time safety spectacles are introduced into the plant and emphasize it by photographs and detailed description of the workmen in their own or other plants, showing the absolute necessity for eye protection. Collect and exhibit every broken spectacle and emphasize the protection it has afforded. Advertise serious eye accidents occurring in other industries. Show the spectacles to the foremen and report at every foremen's meeting every eye accident.

"If the State legislature has the right to force upon the employer compulsory State compensation laws, surely the employer has the right to protect himself by insisting on the workmen using proper devices to prevent accidents.

"The whole eye accident problem is primarily in the hands of the department foremen. Employers will not have much trouble in inducing workmen to wear safety spectacles if all the foremen are actually in sympathy with the use of them and if they will follow ordinary methods of discipline in their use.

"The workmen soon find out when the foremen are not in sympathy with the use of spectacles or are indifferent to their use. It is then the so-called difficulties of inducing the workmen to wear safety spectacles begin to appear and finally become absolute."

The foregoing extract, from a report of a man who has made a careful study of the subject and one who has experienced great difficulties in getting safety spectacles worn, puts the matter up to the foremen entirely. This report is especially applicable to the boiler shop, and writing from twenty years' experience in the boiler shop and around the shop generally, the safety appliances can be enforced by the dismissal of the worst offenders if they persist in it. Firmness should be maintained in this as in other things and by keeping eternally at it.

It may be well to add that in shops where traveling cranes are used the weight of the principal heavy articles to be moved should be placed on a card in the crane man's cage in plain view, and the crane man be instructed to refuse to lift anything if he fears an overload.

In conclusion a few "dont's" may be added that may prove of benefit.

Don't go under a crane load of material, unless absolutely necessary.

Don't try to shear small pieces of plate without a dog or tongs.

Don't watch any one using a pneumatic chipper.

Many companies furnish goggles for chipping, etc. Use them.

Report anything that does not appear safe.

Don't strike tempered steel with a hammer.

Be careful of the long-stroke riveting hammer. If you let the

hammer down for a few minutes put the plunger in your pocket.

Keep the ragged burrs broken off your hand tools.

Don't use a hand hammer or sledge with a loose handle.

When knocking off rivet heads, hold an old broom in front of the rivet.

Don't take hold of a staybolt tap until the motor stops.

Don't punch half holes on the power punch.

Don't monkey with electrical equipment.

Don't wear gloves when operating an air motor.

Don't watch the acetylene or electric welder unless you wear colored glasses.

If it isn't safe—don't do it.

Appoint yourself a committee of one on "Safety First."

"All that a man hath will he give for his life."—*The Boiler Maker.*

POWDERED COAL AS FUEL.

That powdered coal has not come into more general use as a locomotive fuel is due to a want of knowledge of the correct way it should be handled. In the first place, it must be thoroughly pulverized and dried, a detail which has often been neglected in the endeavor to do the pulverizing in a way on the locomotive itself. In such cases the pulverized material from time to time constantly varies with the size of the lump, its hardness and the amount of moisture it contains, and consequently the proportion of air to the proportion of coal varies and combustion is irregular. In the next place, pulverized coal is often supplied to the firebox under too high a velocity, with the consequence that the heat generated is so intense as to destroy the firebrick lining and otherwise to injure the furnace. The recommended way is to blow it into the furnace with only enough air to float it in the form of a dust cloud, that is to say, with 1 or 2 lbs. of air to the pound of coal, another 12 lbs. of air for the purposes of combustion being supplied by natural induced draft alone, just as when coal is burnt in the ordinary way on the grate. The way this is done is by the use of a duplex nozzle, the inner one carrying the coal dust and the larger outer one the combustion air, both properly regulated. In a large locomotive three such nozzles are provided above in the front of the firebox, each the size of a fire door, and below three larger auxiliary openings provided with adjustable air control. A tendency with dust coal fuel is to form slag freely, which should be got rid of by providing an opening in the bottom of the firebox towards which there is a good slope, so that the slag as it forms may fall through and be collected in a pan of water underneath. The fineness of the coal dust should be such that 95 per cent of it will pass through a 100-mesh screen and 85 per cent through a 200-mesh screen, and it should not contain over 5 per cent of free moisture. Some of the advantages of the use of dust coal are, that it results in a saving of one-third of the coal through more perfect combustion, no ash-pits and cleaning gangs are required, the fire can be cut off at will, there is little smoke and consequently a saving in cleaning and painting properties; on a shunting engine no fireman need be employed, and inferior qualities of coal may be used.—*Indian Engineering* (Calcutta.)

THINK HOW MUCH it would mean for the protection of yourselves, your families and the public if every employe of this system would actually correct even one unsafe condition or practice a year. You may correct many, and the place for each one to begin is with himself. Unsafe practices cause twice as many injuries as unsafe conditions. So that the one thing of supreme importance on a railroad is to have safe men. Safe men will bring about both safe practices and safe conditions and the two together will reduce the personal injury record to the lowest possible point.—From a Grand Trunk circular.

INCREASING THE FACILITIES OF THE CAR REPAIR SHOP

By Louis Brentnall

Today the car department is oftentimes overburdened with repair work, because a much larger number of cars are in operation nowadays than a number of years ago and freight traffic has reached the highest point in the history of railroading. One string of bad order cars is no sooner made ready for service than two strings are switched to the car shop for similar attention. Again, there is not only a larger number of cars to handle, but the cars are generally of larger capacity than those which were in service several years ago, requiring more materials in making repairs and a longer time in which to do the work. Besides, there are not only cars of wood construction, but those of steel construction as well, especially as to underframes, car ends, and miscellaneous metal parts, and while the latter may not wear out as wooden parts do, yet they frequently become bent from one cause or another, principally on account of unavoidable derailments, and require re-riveting or straightening. The safety appliance laws, also, require the car department to be more watchful and diligent of minor repairs than in the past and most master car builders or master mechanics nowadays give these small repairs preferred attention, inasmuch as a missing handhold might cause a trainman to lose his grip, while defective airbrakes are sure to cause trouble on the road; hence, inspectors and repairmen are specially instructed to give safety items the most exacting attention, with the understanding that neglect of such defects will bring a reprimand or cause dismissal from the service.

Make All Heavy Repairs at a Central Shop

Concentration of facilities is of greater moment today than any other single feature. All the "old hulks" and badly damaged cars should be sent to a main repair shop, equipped for handling all kinds of heavy car work. Outside repair stations may handle running repairs, but when it comes to heavy work it is oftentimes better to transfer the load from a damaged car and mark it "B. O.—Main Shop." Small points have enough to do in attending to running repairs during these busy times. It takes twice as long to make heavy repairs at small stations, and in many cases the repair men there find they must make only temporary repairs on account of not having standard materials or facilities adequate to handle the work.

The Car Repair Shed a Modern Innovation

In olden days repairmen stood outdoors summer and winter, repairing cars. When it rained or snowed the men were laid off. Small repair points encounter about the same conditions today, hence the need of making all heavy repairs in a main shop, which is necessary in order to keep up with traffic requirements.

Today, many railroads have installed large freight car repair sheds, some of these being very long and having from six to a dozen tracks upon which cars are given heavy repairs, summer and winter, rain or shine. It has been found good practice to use only about every other track in making repairs, the second track being used for push-car service—bringing in new materials to be used in repairing cars on the two adjacent tracks, as well as for relieving the shed of all the scrap iron and old siding and sills. Distance between the tracks should be wide and the roof should be high.

The car repair shed should be under the direction of a general foreman, who should do no other work than direct the movements of his foremen, of which he should have a goodly number, as a truck foreman, a car body foreman, an airbrake foreman, etc. These foremen may also have gang bosses on each repair track in the shed. Thus, when the master car builder or master mechanic issues a car repair order to his general car foreman, the order is passed down the line almost instantly and the repair work promptly completed. A shop telephone

system greatly facilitates issuing orders in a car department and pays for itself several times over during the year. Phones may be installed on posts between tracks, and also at the ends of the shop.

The facilities of the car shed should comprise circular saws sufficiently large for sawing posts or small beams, which may be installed between tracks, and operated by electric motor, thereby enabling the workmen to throw them into operation as needed. Small, overhead cranes, electrically operated, are also a good trick in lifting up ends of cars in removing trucks and allowing the blocking of car body sufficiently high to be out of the way, or for transferring parts of steel cars onto trucks or push cars, or handling heavy sills from supply car to car being repaired. Plenty of jacks are also needed; to tug one of these from one place to another takes time, and it is therefore cheaper in a large shop to have a surplus of jacks than only a few. Sledges, hammers, wrenches, etc., should be kept in kits and each gang held accountable for them. An enthusiastic foreman, in fact, will do away with all the hand work possible, by using electric augers, pneumatic trimming saws and air hammers.

While machine shop men have heretofore been given most of the credit for mechanical ingenuity, as well as being paid the highest salary in some shops, yet car shop or wood machinists are multiplying and will no doubt very soon show mechanics some tricks in improved car shop facilities, for much of the car work which is now done by hand can be handled more efficiently with machine tools and machinery.

A good system of electric lighting is necessary in the car shed, for there are many dark days during a year, and again, most car shops will have to work long hours if traffic is as good in 1914 as it was in 1913.

The Mill

Here is where the bolsters and heavy sills are made ready for application to cars. Most railroads have cars designated by classes or capacities, with sills and beams standard in these classes; hence the mill can saw one style of beam or bolster one day, and another style or standard the next day. This finished material may be kept in front part of repair shed, or near at hand, with a foreman in charge, familiar with materials of different dimensions, who will issue the required sills or beams to the different shed tracks as ordered—all the heavy sawing, etc., to be done in the mill.

Where the mill also handles passenger car materials it must necessarily be well equipped with wood-working machinery, as mortising machines, wood turners, sandpapering machines (also called wood polishers), etc., are required. Many mills have scant equipment for turning out finished car materials easily and quickly. The mill should be in charge of a foreman. For passenger car mill work, generally, a finer and different work, a different or independent foreman is really needed.

The Steel-Working Blacksmith Shop

Heretofore much of the steel work on many railroads has been handled in the blacksmith shop attached to the locomotive shop, but nowadays an independent shop is needed on some roads for straightening metal parts, cutting rivets and re-riveting. The car repairer who is required to do such work by hand is apt to damn his job, for most repairs of this kind requires a Hercules to do it even slowly. Bending machines, straightening machines, power cutters, pneumatic hammers, electric cranes, etc., are required on different kinds of steel car work. It should be remembered that not only has the number of freight cars with steel underframes and metal ends increased greatly, but many passenger coaches are today all-steel, and if the repair of metal cars is to be kept up, straightening parts, riveting, etc., it is going to be necessary to have machinery to work with. A steel-working blacksmith shop where all riveting and straightening or rebuilding (with a lesser amount of the latter) can be done, is necessary, even to riveting coupler yokes, straightening truss rods, and miscellaneous small work of this kind, which is now none too light in the average car repair shop.

The Ideal Car Repair Shop and Its Progressive Foreman

Master mechanics and master car builders are perhaps somewhat backward about asking superiors for better shop facilities, but the ideal car repair shop is similar in kind to the arrangement above suggested, with such variations as necessary to meet local requirements or differences for the better made by the master mechanic himself. Instead of remaining caged as a bird, the master mechanic should visit other railroad shops. An idea gleaned here and there finally makes his shop perfect. There is work being done by hand in the car shop today which will in a year or two be done by machinery. When you see men doing a piece of work by hand that you would like to have done by machinery, put all the heads thinking about it, foremen, shop men, and all. If you do not want to get a patent yourself, put the same question up to the machine builders, and you will find that before long there will be a machine offered you which will do the work. That's the way all machinery was originated. Necessity is the mother of invention. It gives inspiration or causes enthusiasm which directs the mind into the required channel for inventing the machine desired.

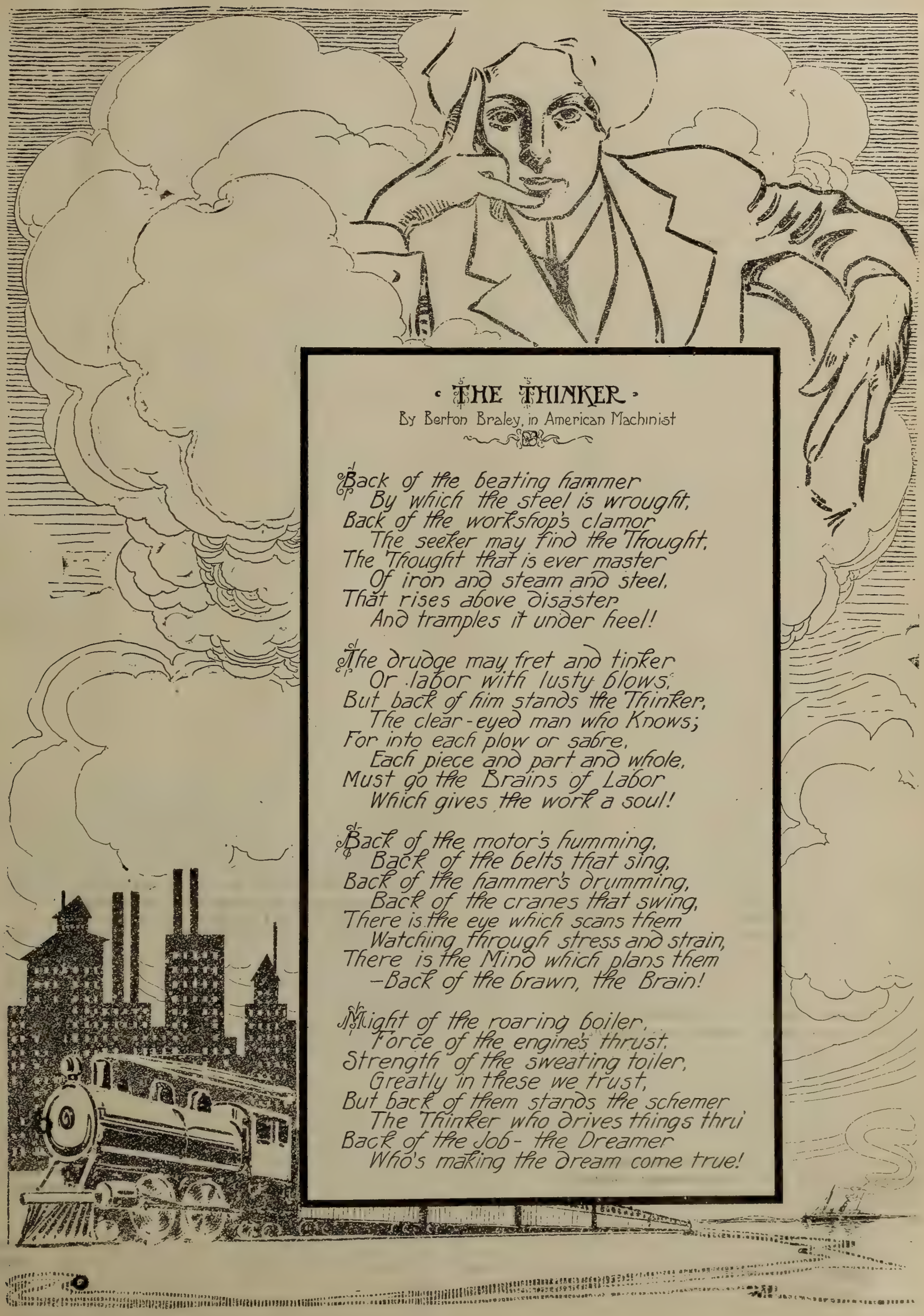
The Car Shop Scrap Pile.

Here's where you get your money back, if you try it. The amount of scrap from a repair shed is enormous. If stacked up for a few weeks it would be as large as the shed itself. Generally, the wood scrap is burned or sold, grabirons, hasps, hooks, bolts, rods, and all. The pity of it is that most of this stuff is good second-hand manufactured materials. True, it hardly pays to remove grabirons, bolts, etc., by hand from old woodwork, but it should be remunerative where a workman is given a pneumatic chopper for splitting the wood and other necessary facilities. By arranging facilities for handling the scrap systematically the master mechanic should be entitled to an unsolicited increase in salary; at any rate, it offers him a lever when reporting "How I Have Increased the Facilities of My Car Repair Shop."

The improvement of car shop repair facilities are dependent first upon the master mechanic and secondarily upon the management, for where he is in position to show how work can be handled quickly, better and more economically, he should not dread stating his proposition nor fear being repulsed for his forwardness, but rather he should be rewarded for his progressiveness.

THE PENNSYLVANIA has issued instructions to superintendents prohibiting the destruction of railroad equipment involved in an accident causing loss of life or injuries to passengers, until public officials have had ample opportunity to examine the same. It is not intended that any such rule should operate to prevent the promptest possible resumption of traffic, nor that such equipment shall remain for any great length of time along the right of way. The company feels that it may reasonably expect public officials desiring to make such an examination to do so quite promptly.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS are conducting a large number of courses for railway employes. An example of the interest being aroused among railway men is shown by the number of students enrolled in the Florida East Coast Ry. In July there were 24 students enrolled and this number increased to 33 on August 1, to 34 on September 1, and to 41 on October 1. The number of lessons given in the meantime increased from 61 to 125. During the five weeks ending October 4, the total number of lessons received and corrected from railways employes was increased from 20,180 per week to 26,520 per week, the total being 121,244.



THE THINKER

By Berton Braley, in American Machinist

Back of the beating hammer
By which the steel is wrought,
Back of the workshop's clamor
The seeker may find the Thought,
The Thought that is ever master
Of iron and steam and steel,
That rises above disaster
And tramples it under heel!

The drudge may fret and tinker
Or labor with lusty blows,
But back of him stands the Thinker,
The clear-eyed man who Knows;
For into each plow or sabre,
Each piece and part and whole,
Must go the Brains of Labor
Which gives the work a soul!

Back of the motor's humming,
Back of the belts that sing,
Back of the hammer's drumming,
Back of the cranes that swing,
There is the eye which scans them
Watching through stress and strain,
There is the Mind which plans them
—Back of the brawn, the Brain!

Might of the roaring boiler,
Force of the engine's thrust,
Strength of the sweating toiler,
Greatly in these we trust,
But back of them stands the schemer
The Thinker who drives things thru'
Back of the Job- the Dreamer
Who's making the dream come true!

ELECTRIC LOCOMOTIVES, N. Y. C. & H. R.

The New York Central & Hudson River has recently ordered six additional passenger electric locomotives from the General Electric Company for terminal service out of New York city. Early in the year ten electric locomotives of the most powerful type ever built were ordered from this company for the same service, weighing 100 tons each. These were described in the May issue. While the new machines are of the same type and construction, they are somewhat heavier, weighing 110 tons, and due to recent advancement in locomotive design, have materially increased capacity for continuous service.

The growth in traffic and the corresponding increase in the demand for larger and heavier train units since the introduction of electric locomotives in the New York Central terminal has been indeed notable. In 1906 thirty-five 600-volt, direct current, passenger electric locomotives were built by the General Electric Company and introduced in the terminal. These machines are of the 115-ton, 4-8-4 type and are each equipped with four GE-84 bipolar, gearless motors. Twelve more engines of the same type were placed in service in 1908. All these locomotives were designed with sufficient tractive effort to operate 535-ton gross weight trains at 60 miles per hour in the regular terminal service.

The weight of trains which are being hauled out of the terminal is ever increasing steadily, and some of the more important trains now weigh over 1,000 tons. It has, therefore, been deemed desirable to have engines for the maximum service with very great continuous capacity, ample overload and high momentary rating. The new locomotives are able to exert practically the same tractive effort continuously that the previous ten locomotives can for one hour.

The increase in weight of ten tons in these machines is accounted for mainly by the greater amount of material in the motors, which are of larger capacity. The speed and torque characteristics of the locomotive have been kept practically the same as those of the former ten machines, but the new locomotives are capable of hauling approximately 40 per cent greater tonnage in continuous service.

The previous ten 100-ton locomotives have a capacity for developing 1,460 horsepower continuously, 2,000 horsepower for one hour and can develop as high as 5,000 horsepower for short periods. This corresponds to a tractive effort of 9,000 pounds at sixty miles per hour continuously or 13,500 pounds at fifty-four miles per hour at the one hour rating. The six new electric engines will develop 2,000 horsepower continuously, or 2,600 horsepower for one hour. The equivalent tractive effort is 14,000 pounds at fifty-four miles per hour continuously, or 20,000 pounds at forty-nine miles per hour at the one hour rating. They are able to haul 1,100-ton trains in continual service between the terminal and Harmon, are capable of operating 1,200-ton trains in emergency service, and 1,200-ton trains on level tangent track continuously at sixty miles per hour.

In point of design and construction the new machines will be of identically the same type as the former ten engines, having articulated frame with bogie guiding trucks at each end.

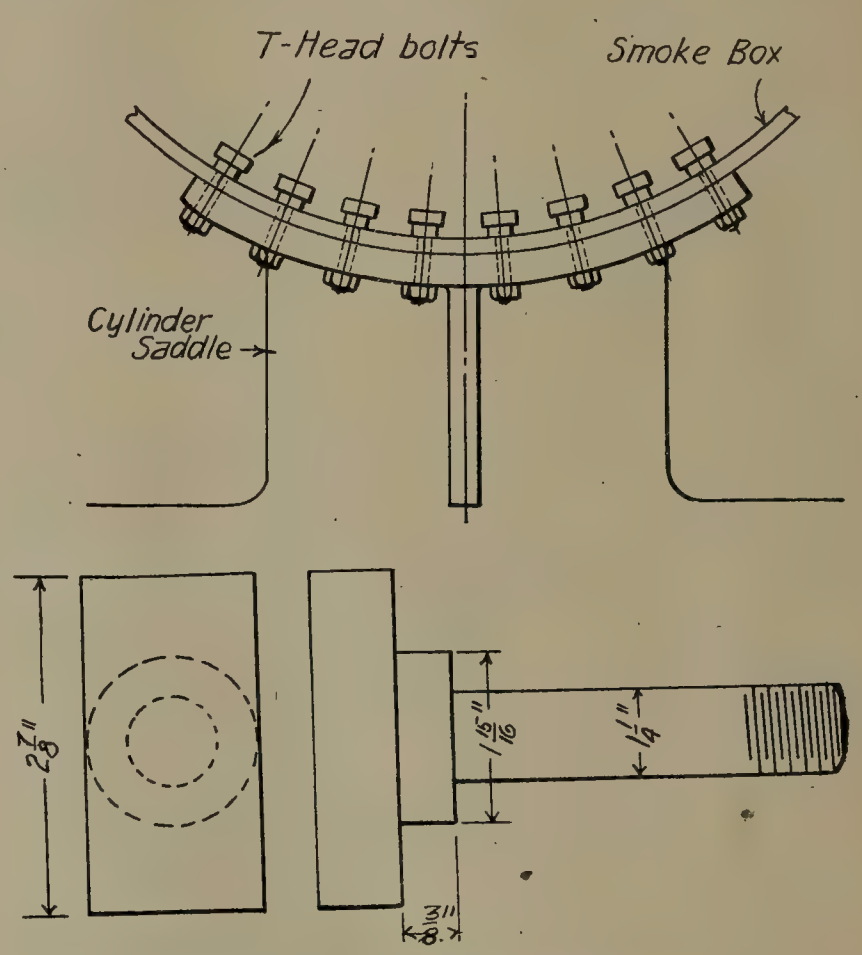
The new locomotives are now under construction in the works of the General Electric Company at Schenectady, N. Y., and will be placed in operation as soon as completed. Compared with existing types of electric engines, these machines have greater capacity and higher efficiency than any other high speed electric locomotives ever constructed. Withal, the total weight, weight per driving axle and "dead weight" is less than that of any other locomotive approaching their capacity.

The name of The Railroad and Current Mechanics, a monthly magazine published by the Frank A. Munsey Co., has been changed to the Railroad Man's Magazine, which was its name previous to July, 1913. The change was made in response to a demand from its readers that it return to its old form.

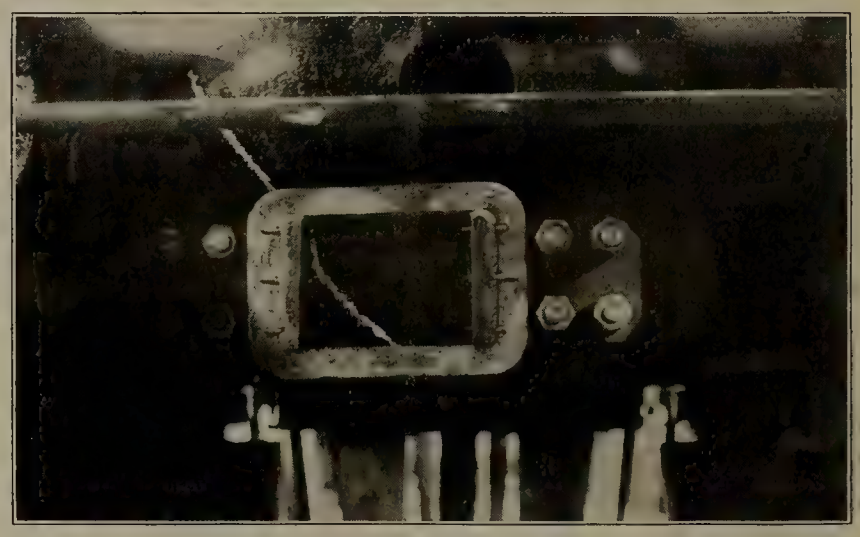
CYLINDER SADDLE KINKS.

By James Stevenson, Altoona, Pa.

The present-day time limit on repairs makes it necessary to adopt all devices which will give quick results. The sketch shows an interesting method of applying cylinder saddle bolts which can easily be removed by the old style fork wedge. The bolt, it will be noticed, has a $1\frac{5}{16}$" collar which allows the wedge to be inserted under the T head. After the nut has been removed, a slight tap will bring the bolt out very easily with the aid of the wedge. The bolt can also be very effectively used as a frame splice bolt.



Improved Cylinder Saddle Bolt.



Repair to a Cracked Saddle. Crack Indicated by White Line.

The photographic reproduction shows the way in which a cracked cylinder saddle was repaired. Two angle plates were bolted to it, one on each side of the crack, which is indicated by the white line. After this was done a band was pressed over the projecting angles, drawing the two sections together. This made a quick repair and proved satisfactory.

MOTOR BUSES carried 551,493 passengers in Vienna, Austria, during 1912, and covered a total distance of 128,445 miles. These buses are used much more extensively for city transportation in Europe than they are in American cities.

PENNSYLVANIA SAFETY METHODS.

The Pennsylvania Railroad has during the past year devoted particular attention to perfecting its organization for safety. Safe operation has always been their prime aim, but special and intimate study is now being given to every element in operation which might lead to an accident, even indirectly. The methods by which the management follows up all questions of safety are indicated in the following statement:

On each division of the Pennsylvania there is a regular written program for handling wrecks. A designated officer of each department goes to the scene of each accident and a joint investigation is made to determine the cause. The results of the investigation are embodied in detailed reports. These reports pass through the hands of the superintendent, the general superintendent and the general manager. The superintendent takes such action to prevent repetition as may be deemed necessary. The general superintendent checks the work of the superintendent, and finally the general manager, through his Accident Bureau, makes such deductions and draws such conclusions as may be warranted by the facts shown in the reports. This is followed by recommendations which may involve the improvement of machinery, change in methods of operation, or the efficiency and discipline of employes.

All reports, both of personal injuries and train accidents, are tabulated and summarized. These summaries are issued quarterly and yearly and provide the officers with data suggestive of remedial measures. The summaries are also distributed among the men, who receive in that way information as to the experienced thought of the management.

The motive power department is provided with full and complete information as to the number and cost of accidents resulting from motive power defects. Constant and elaborate study is made by this department of the condition of material and the practicability of designs. Changes in unsatisfactory equipment are being continually made. What is said of the motive power department applies also to the maintenance of way department.

The operating department is furnished with figures showing the number and cost of accidents resulting from negligence and inefficiency on the part of operating employes, and such measures are taken to improve the service as may be suggested by the statistics.

In addition, the general manager has a discipline committee, composed of three experienced train masters, who have devoted their time since 1911 to the examination of discipline records of employes in all departments. This committee makes recommendations regarding the condition of records and the manner in which the records are kept. They call attention to the cases of men whose records indicate that they are below a reasonable standard of efficiency, special attention being paid to violations of safety regulations. It is the purpose of the management to place itself in a position to be able to determine, from written records of the men, whether they are rendering safe and efficient service.

The train rules committee is constantly passing upon proposed rules and regulations and changes in the present rules and regulations.

The dispatching committee is composed of five practical subordinate officers, who have been examining into methods of operation on all divisions of the railroad for more than four years. This committee at frequent intervals visits the division headquarters and goes over with the superintendent, division operator, trainmaster and dispatchers all questions relating to the interpretation and application of rules and regulations pertaining to the movement of trains. Any cases of misinterpretation or failure to apply the rules in the prescribed manner are promptly corrected, and such other recommendations are made as may be suggested by the interviews with the division officials. The work of the committee is intended to bring about uniformity as well as safety in the introduction of new rules and the application and interpretation of the old rules.

On each division there are one or more safety committees who inspect the road, yards and shops to see that the equipment is in safe condition and that machines are properly guarded. There are one or more efficiency inspectors on each division, who make tests on the observance of the rules and regulations of the company. An average of approximately 500,000 observations and tests are made monthly.

Briefly stated, the management is making a concerted effort to develop the operation of the road to the highest possible standard of efficiency and safety, and to this end all departments are co-operating.

SAFETY AT GRADE Crossings is urged in a large two colored bulletin which the Pennsylvania R. R. has posted in its stations. Among other things it states:

"There remain on the 11,000 miles of line comprising the Pennsylvania System 13,037 crossings at grade. It costs an average of at least $50,000 to remove a grade crossing. Thus, to eliminate every such crossing on the lines of this system would cost upwards of $600,000,000. The various companies of this system have since 1902 expended $66,641,294 in improvments resulting in the elimination of 1,052 grade crossings."

New Books

TRAVELING ENGINEERS ASSOCIATION. Proceedings of the twenty-first annual convention. Leather, 6x9 inches, 371 pages, illustrated. Published by the secretary, W. O. Thompson, Buffalo, N. Y.

The aim of this association is to improve the locomotive service of America. The volume contains a complete report of the meeting held at the Hotel Sherman, Chicago, on August 12, 13, 14 and 15, 1913, a condensed report of which was published in the September issue of the *Railway Master Mechanic*. The subjects discussed by the convention are "Uniform Instruction to Enginemen on the Handling of Superheat Locomotives," "Credit Due Operating Department For Power Utilization and Train Movement That Reduces the Consumption of Fuel Per Ton Mile," "Care of Locomotive Brake Equipment on Line of Road at Terminals." "Advantage of the Brick Arch," "What can be done to Eliminate the Black Smoke Evil," "Scientific Train Loading-Tonnage Rating." Included also are addresses by W. L. Park, vice president of the Illinois Central; W. A. Garrett, vice president of the Chicago Great Western; W. T. Tollerton, general mechanical superintendent of the Chicago, Rock Island & Pacific, and D. R. MacBain, superintendent of motive power of the Lake Shore & Michigan Southern. The book is bound with a flexible leather cover, has a clear readable type and is in keeping with one of the strongest mechanical associations in the country.

WESTERN RAILWAY CLUB. Proceedings for the year 1912-1913. Cloth, 6x9 inches, 435 pages, illustrated. Published by the secretary, J. W. Taylor, 910 So. Michigan Ave., Chicago.

This club holds its meetings on the third Tuesday of each month, except June, July and August at 910 So. Michigan Ave., Chicago. It has over 1500 members and its meetings are marked by interesting papers and enthusiastic discussions. Probably one of the most interesting papers in this volume is that on "Headlight Tests," by C. M. Larson, the paper and discussion covering over a hundred pages. These tests were conducted by the Railroad Commission of Wisconsin and were quite exhaustive. Other papers presented and discussed are "Electrical Equipment of Railroad Shops," "Superheated Steam," "Safety First Movement," "Locomotive Testing Laboratory of the University of Illinois" and "Testing of Draft Gear." A list of the members is published at the rear of the book.

INTERNATIONAL RAILWAY FUEL ASSOCIATION. Proceedings of the fifth annual convention. Paper, 6x9 inches, 330 pages, illustrated. Published by the secretary, C. G. Hall, 922 McCormick Bldg., Chicago.

This association was organized in 1908 and has made remarkable progress since that time. The fifth annual convention was held at Chicago on May 21, 22, 23 and 24, 1913, and its sessions were profitable and well attended. Among the subjects taken up are, "Construction Development and Operation of a Bituminous Coal Mine," "Firing Practice on Locomotives," "Self-propelled Railway Passenger Cars," "Design, Construction and Operation of a Modern Locomotive Coaling Station," "Scaling of Locomotive Boilers and Resultant Fuel Loss," "Standard Form of Contract, Covering Purchase of Railway Fuel Coal" and "Sub-bituminous and Lignitic Coal as Locomotive Fuel."

INTERNATIONAL RAILWAY GENERAL FOREMENS' ASSOCIATION. Proceedings of the ninth annual convention. Paper, 6x9 inches, 175 pages illustrated. Published by the secretary, William Hall, 829 W. Broadway, Winona, Minn.

The meeting reported in this volume was held at the Hotel Sherman, Chicago, Ill., on July 15, 16 and 17, 1913. The proceedings contain papers and discussions on "Superheated Locomotives," "Apprentice Systems," "Shop Schedules," "Driving Box Work" and "Engine House Efficiency," together with a number of addresses by prominent railway men. The field covered by this association is a very important one.

Personals

R. C. WALLACE succeeds A. E. McMillan as general foreman of the Baltimore & Ohio Southwestern at Cincinnati, O.

J. A. BARKER has been appointed road foreman of engines of the Chesapeake & Ohio of Indiana, with office at Peru, Ind.

W. W. ELDRIDGE has been appointed inspector of stores of the Chicago, Burlington & Quincy, with office at Chicago. He succeeds D. C. Curtis.

A. QUADE succeeds M. F. Michaels as master car and locomotive painter of the Chicago, Milwaukee & St. Paul at Dubuque, Ia.

W. P. FITZGERALD succeeds J. C. Rhodes as master mechanic of the Chicago, Rock Island & Pacific at Estherville, Ia.

WILLIAM GERMER succeeds P. Smith as road foreman of equipment of the Chicago, Rock Island & Pacific, with office at Chicago, Ill.

H. G. DYKE succeeds W. B. Bunn as general foreman of the Cincinnati, New Orleans & Texas Pacific, with office at Danville, Ky.

W. B. BUNN succeeds J. A. Cassady as general foreman of the Cincinnati, New Orleans & Texas Pacific, with office at Chattanooga, Tenn.

WILLIAM EWALD has been appointed superintendent of motive power of the Cumberland & Pennsylvania, with office at Mt. Savage, Md.

B. E. ROOSA succeeds G. H. Eck as general foreman motive power department of the Delaware, Lackawanna & Western. His office is at Syracuse, N. Y.

B. POWERS has been appointed road foreman of engines of the Detroit, Toledo & Ironton, with headquarters at Springfield, O.

C. PETERSON has been appointed storekeeper of the Great Northern at Tacoma, Wash. He succeeds C. Clark.

F. J. SAUNDERS succeeds G. B. Hoult as storekeeper of the Great Northern at Havre, Mont.

J. D. BROWN succeeds L. M. Miller as locomotive foreman of the Great Northern at Billings, Mont.

NICK HAHN succeeds F. W. Ramer as locomotive foreman of the Great Northern at Glasgow, Mont.

F. W. RAMER has been appointed locomotive foreman of the Great Northern, with office at Havre, Mont.

M. A. HALL has been appointed superintendent of shops of the Kansas City Southern at Pittsburg, Kan. He succeeds C. W. Bugbee.

W. J. FREY has been appointed supervisor of materials of the Lake Shore & Michigan Southern, vice H. W. Gardner, resigned. His office is at Cleveland, O.

W. H. RIPLEY has been appointed general foreman of the Lake Shore & Michigan Southern at Englewood, Chicago. He succeeds Alfred Herbster.

ALFRED HERBSTER has been appointed traveling car foreman of the Lake Shore & Michigan Southern, with headquarters at Cleveland, O.

W. O. JAMISON has been appointed storekeeper of the Mobile & Ohio at Tuscaloosa, Ala.

J. H. DALEY has been appointed master mechanic of the New York, New Haven & Hartford, with office at Taunton, Mass.

A. W. NELSON has been appointed master mechanic of the New York, New Haven & Hartford, with office at Waterbury, Conn.

E. W. ALLING, master mechanic of the New York, New Haven & Hartford has been transferred from Taunton, Mass., to New Haven, Conn., succeeding W. S. Clarkson.

C. H. REID, master mechanic of the New York, New Haven & Hartford, has been transferred from Waterbury, Conn., to Providence, R. I.

K. G. CHAPMAN succeeds W. W. Crosby as road foreman of engines of the Northern Pacific, with office at Lester, Wash.

L. L. MOEBECK has been appointed road foreman of engines of the Northern Pacific, with headquarters at East Grand Forks, Minn.

J. M. GAILEY has been appointed acting master mechanic of the San Pedro, Los Angeles & Salt Lake, with office at Milford, Utah. He succeeds J. R. Greiner.

FRED C. SIMPSON has been appointed general foreman of the Southern at Asheville, N. C., succeedings E. L. Akans.

CHARLES MANLEY has been appointed superintendent of motive power of the Tehuantepec National, succeeding H. P. Durham. His office is at Rincon Antonio, Oax., Mexica.

F. N. DOBBS succeeds A. S. McKelligan as storekeeper of the Southern Pacific at Brooklyn, Ore.

A. S. MCKELLIGAN, storekeeper of the Southern Pacific, has been transferred from Brooklyn, Ore., to West Oakland, Cal.

F. H. POTTER succeeds I. L. Ward as storekeeper of the Southern Pacific at Sacramento, Cal.

J. Z. KUHNS has been appointed general foreman of the Atchison, Topeka & Santa Fe, with office at Clovis, N. M. He succeeds Thomas Booth.

J. SHEPPARD succeeds W. J. Pickerel as district master mechanic of the Ontario division of the Canadian Pacific. His office is at West Toronto, Ont.

J. P. BURNS has been appointed foreman of locomotive repairs of the Pennsylvania at Wellsville, O.

A. M. BAIRD has been appointed assistant superintendent in charge of the locomotive shops of the Atchison, Topeka & Santa Fe at Topeka, Kan.

G. H. WATKINS has been appointed assistant master mechanic of the Pennsylvania at Pittsburgh, Pa.

F. L. DOBSON succeeds G. H. Watkins as assistant master mechanic of the Pennsylvania at Meadows Shop, Jersey City, N. J.

G. L. BENNETT succeeds G. C. Weight as foreman car shops of the Pennsylvania at Erie, Pa.

E. A. CLIFFORD has been appointed assistant general purchasing agent of the Atchison, Topeko & Santa Fe, with headquarters at Chicago.

F. E. CONNORS has been appointed assistant to vice-president of the Atchison, Topeka & Santa Fe, in charge of stores with office at Topeka, Kan.

N. M. RICE has been appointed chief purchasing officer of the St. Louis & San Francisco, with office at St. Louis. Mr. Rice was formerly general storekeeper of the Atchison, Topeka & Santa Fe.

GEORGE H. FUNK has been appointed chief smoke inspector for all roads entering Cincinnati, O.

C. BOWERSOX has been appointed master mechanic of the Toledo & Ohio Central, with office at Bucyrus, O. Mr. Bowers entered railway service as messenger in the master mechanic's office of the Baltimore & Ohio at Garrett, Ind. He entered the shops as machinist apprentice at the same point, completing the trade, and after working one year as machinist, was employed as fireman and afterwards promoted to engineer. After running an engine two years, he again returned to the machinist trade, later being promoted to gang foreman. Later he left the Baltimore & Ohio and took service with the Toledo, St. Louis & Western as erecting shop foreman, later being promoted to roundhouse foreman, and still later to general foreman. Two years ago he was appointed general foreman of the Toledo & Ohio Central at Bucyrus, which position he held until his present promotion.

J. A. CASSADY has been appointed master mechanic of the Alabama Great Southern, with office at Birmingham, Ala. Mr. Cassaday began railway work in 1898 as an apprentice on the Lexington & Eastern, and in 1902 was appointed master mechanic of this road. He left this position to enter the service of the American Metallic Packing Co., but later returned to railway work as erecting shop foreman of the Chesapeake & Ohio. In 1904 he became mechanical advisor to the Anniston Stove & Foundry Co. During the latter part of 1906 he accepted the position of assistant roundhouse foreman of the Cincinnati, New Orleans & Texas Pacific at Chattanooga, Tenn., later being appointed erecting shop foreman at the same point. In 1907 he was appointed general foreman at Oakdale, Tenn., and during the latter part of 1911 was transferred to Chattanooga, which position he held until his recent appointment.

HAROLD B. HAYES has been appointed master mechanic of the Cincinnati, New Orleans & Texas Pacific, with office at Somerset, Kentucky. Mr. Hayes was born on September 13, 1882, in Alabama, and was educated at Birmingham. He began railway work in 1895 as an apprentice in the master mechanic's office of the Southern Railway and in 1900 was transferred in the same capacity to Atlanta, Ga. Three years later he went to the Missouri Pacific as roundhouse foreman at Little Rock, Ark., and was then appointed general foreman of the Arkansas divison at McGehee. In 1906 he was appointed general foreman of the Cincinnati, New Orleans & Texas Pacific at Danville, Ky., and was promoted to master mechanic in November, 1910, with office at Chattanooga, Tenn., which position he held until October, 1912., at which time he was promoted to the position of master mechanic of the Alabama Great Southern, with office at Birmingham, Ala., in which capacity he served until his promotion as above noted.

William V. Wicks has been appointed road foreman of engines of the Northern Pacific, with headquarters at Jamestown, N. D.

J. V. B. Duerr succeeds B. F. Wood as assistant engineer, motive power department, of the Pennsylvania, with office at Altoona, Pa.

J. M. Henry has been appointed superintendent of motive power of the Pennsylvania, with office at Pittsburgh, Pa.

G. C. Gardner, Jr., succeeds P. L. Grove as superintendent of motive power of the Pennsylvania at Buffalo, N. Y.

E. Sumner, master mechanic of the Pensylvania, has been transferred from Sunbury, Pa., to Philadelphia, Pa.

P. L. Grove has been appointed master mechanic of the Pennsylvania at Sunbury, Pa.

A. H. Shoup succeeds D. Hengstler as car foreman of the Pennsylvania at Cresson, Pa.

J. W. Baum has been appointed general foreman of the Pennsylvania Southern, with office at Clarion, Pa.

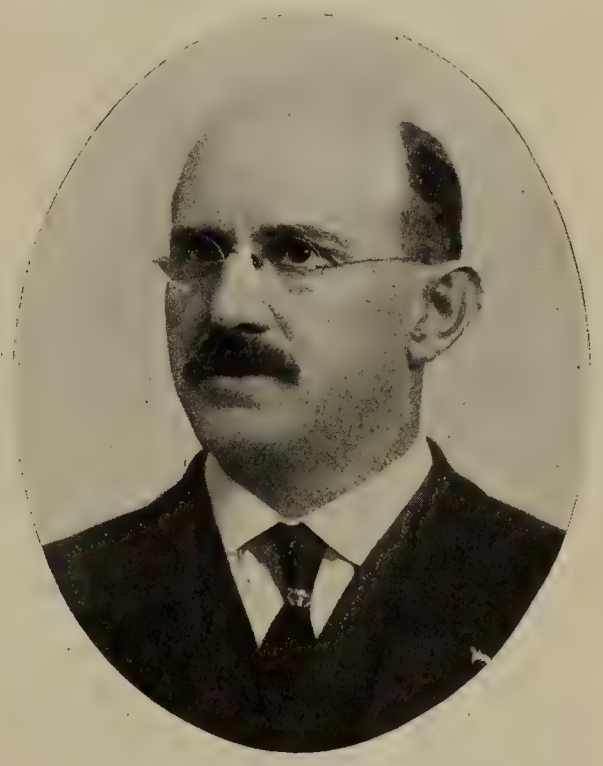
C. L. Sykes has been appointed master mechanic of the Orangeburg, with office at Orangeburg, S. C.

Fairfax Harrison, president of the Chicago, Indianapolis & Louisville, was elected president of the Southern on December 1 to succeed the late W. W. Finley.

Henry Martin, second vice president and general manager of the International & Great Northern, was drowned on December 5 at Valley Junction, Tex., in the Brazos river floods. Mr. Martin was personally superintending efforts to restore service in flooded regions.

JOSEPH FORSCHE has been appointed general car foreman of the Lake Erie & Western at Lima, Ohio., succeeding W. J. Frey. Mr. Forsche began railroad work in the Ft. Wayne shops of the Ft. Wayne, Cincinnati & Louisville in December, 1889, as a car repairer and inspector. In October, 1890, this road was purchased by the Lake Erie & Western and Mr. Forsche remained at Ft. Wayne until 1896, when he was transferred to the Lima, Ohio, shops of the same road. In 1907 he was promoted to mill and coach foreman, which position he held until his present appointment.

B. E. GREENWOOD, as announced in our last issue, has been appointed shop superintendent of the Seaboard Air Line, with office at Portsmouth, Va. Mr. Greenwood was born January 23, 1865, at Shepherdstown, W. Va. After two years at Shepherds College, he became somewhat interested in machinery and after serving an apprenticeship in the agricultural and steam engine work, left Shepherdstown in January, 1886, to enter the Roanoke Machine Works (now the Norfolk & Western Railway shops), at Roanoke, Va. He worked for the Norfolk & Western as machinist until



B. E. GREENWOOD.

1892 at which time he was promoted to gang foreman in the erecting shop. In the year 1896, he was promoted to roundhouse foreman at West Roanoke, remaining there until February, 1898, he resigned to become general foreman of the Richmond Locomotive Works at Richmond, Va. In the fall of 1898 he returned to the Norfolk & Western at Roanoke and was made foreman of the erecting shop. On May 1, 1900, he accepted a position as general foreman of the Lake Shore and Michigan Southern at Buffalo, later being transferred to the main shops at Cleveland, where he remained until August 15, 1902, on which date he resigned to accept the position of general foreman of the main shops of the Seaboard Air Line at Portsmouth, Va., holding this position until his present appointment.

E. W. SMITH, as announced in our last issue, has been appointed assistant master mechanic of the Philadelphia, Baltimore & Washington, with office at Wilmington, Del. Mr. Smith graduated from the Virginia Polytechnic Institute in June, 1905, and entered the Philadelphia, Baltimore & Washington shops at Wilmington as a shop hand. He remained here for about eight months and resigned to become an erecting machinist at the Reading shops of the Philadelphia & Reading. He left the Reading to enter the service of the Tennessee Coal, Iron & Railroad Co., as a machinist in the Ensley, Ala., shop, and on August 1, 1906, became special

apprentice in the Altoona, Pa., shops of the Pennsylvania. After completing the apprenticeship course he was assigned to the general manager's office as an inspector and on September 1, 1912, was appointed motive power foreman in the same department. In April, 1913, he was transferred to the general superintendent of motive power's office on special work in connection with enginehouses, and on October 15, was appointed to his present position.

G. E. SMART, as announced in our last issue, has been appointed master car builder of the Intercolonial, with office at Moncton, N. B. Mr. Smart was born December 23, 1873, at Edinburgh, Scotland, and entered the service of the Grand Trunk at Montreal in 1892, working in various positions in the car shop until 1897. He was then transferred to yard service as car inspector and in 1904 was appointed general inspector heating and lighting, eastern lines of the Canadian Pacific. In 1909 he was made divisional car foreman in charge of passenger and freight car work, Eastern Division, Canadian Pacific, which position he held until his recent appointment.

New Literature

The R. K. Le Blond Machine Tool Co., Cincinnati, O., has issued a booklet descriptive of a mechanical belt shifter for use on lathes, milling machines and tools of like nature. It is a safety device and can be applied to any cone-driven machine. Turning a crank shifts the belt.

* * *

Bulletin 1016 of the American Locomotive Co., New York, is devoted to Pacific type locomotives. A tabular comparison of Pacific type locomotives built for various roads is given together with illustrations of same.

* * *

The Gilbert & Barker Mfg. Co., Springfield, Mass., has issued a booklet descriptive of the Gilbert & Barker process for burning fuel oil under low pressure. The air for these burners is carried at a pressure of one and one-half pounds and upward per square inch on account of the peculiar construction of the boiler. An interesting table is given showing a comparison of oil fuel with various gaseous fuels as to heating value.

* * *

G. L. Simonds & Co., Chicago, Ill., have issued a very attractive catalogue of the Vulcan soot cleaner which is manufactured by the Vulcan Soot Cleaner Co., of Pittsburgh. The Vulcan cleaner consists of long blow pipes carried across the full width of the boiler which discharge blasts of steam between the tubes. The system is especially designed for each installation and where stationary blow pipes will not cover the entire area, a number of blow pipes are so placed that they can be rotated. "You cover your steam mains—then why not uncover your boiler tubes," says the booklet, and there is much truth in the statement. A number of illustrations are given among which is a view of an installment on the Chicago & North Western Railway.

* * *

Catalogue number 166 entitled "Dayton Car Lighting Fixtures" has just been issued by the Dayton Manufacturing Co., Dayton, O. It is distinctly a high class catalogue, being 9x12 inches in size, bound in cloth and printed on enameled paper. It illustrates and enumerates practically all the fixtures needed in the illumination of modern railway cars and contains 158 pages. The book is prefaced by a comprehensive index and is divided into sections devoted respectively to: electric car lighting fixtures, acetylene gas car lighting fixtures, oil car lighting fixtures, smokeless auxiliary candle lamps, parts and accessories. One of the special features shown is the "Flex" shade holder which by means of a coiled wire spring clamps the glass at every point and with the same pressure. The glassware may be removed instantly and the holder affects a considerable saving in glassware any time.

The Selling Side

The Okadee Co. of Chicago has been incorporated for the purpose of dealing in railway supplies and equipment. The capital stock is $25,000 and the incorporators are Marshall E. Keig, Arthur G. Hollingshead and Paul Carpenter.

The name of the firm of John C. Knight, Inc., New York, N. Y., has been changed to the Sauvage-Ward Brake Co.

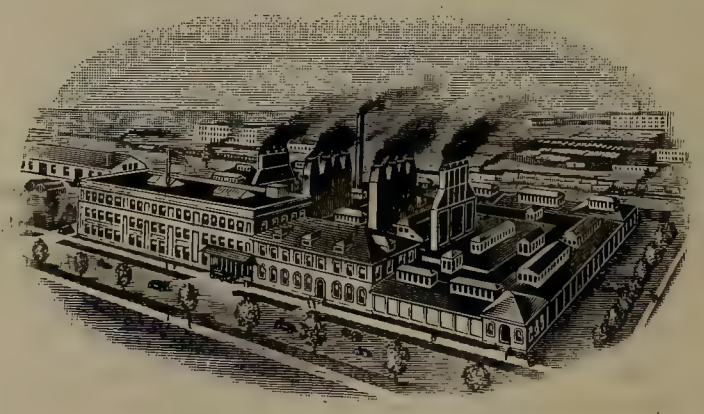
H. E. Gifford, Jr., has been appointed sales manager for the National Electric Specialty Co., Toledo, O., with headquarters in Chicago, having resigned as western representative of the L. S. Brach Supply Co. to accept this position. Mr. Gifford has been in the signal business since 1905, when he went to work for the New York Central at Mott Haven, N. Y., as accountant in the office from which the electric zone work was handled. He was appointed chief clerk to Azel Ames, then signal engineer of the electric zone, in May, 1906. When the organization was disbanded in the latter part of 1907 he went into the accounting department of the Union Switch & Signal Co.'s Pennsylvania terminal construction organization. In 1910 he entered the employ of the American Conduit Co. and was later connected with the installation of the underground conduit system of the New York, Westchester & Boston. He was appointed western representative for the L. S. Branch Co. in January, 1912.

The Easton Car & Construction Co., Easton, Pa., has purchased all of the business of the Ernst-Wiener Co., and will continue the business of manufacturing industrial railway equipment, cars, track, etc.

Horace L. Winslow has disposed of his interest in the Okadee Company and will give his time exclusively to the Horace L. Winslow Company, Inc.

M. G. Doll has been appointed general sales manager of the Bury Compressor Co., Erie, Pa.

The Flint Varnish Works, Flint, Mich., has increased its capitalization to $1,000,000 and in the reorganization W. W. Mountain, formerly general manager, has been made president. The larger capital was made necessary to provide facilities with which to take care of the large increase in the company's business, it having increased over 100% in the past few months. The Flint Varnish Works first came into existence as a department of the Durant-Dort Carriage Co. In Janu-



Plant of the Flint Varnish Works.

ary, 1909, Mr. Mountain became affiliated with the company. Shortly afterwards a three-story plant was constructed and the manufacture of a full line of paints and varnishes for automobile and railway trade was carried on. In 1910 the Flint Varnish Works was incorporated and a large four-story building was erected. It is now the plan to extend the business still further and to meet every demand in the paint and varnish trade. Through the reorganization the following became directors: C. W. Nash, J. Dallas Dort and W. W. Mountain of Flint, R. R. Scott of Toledo and A. H. Goss of Detroit. Mr. Mountain will continue as general manager in addition to assuming the duties of president. His new positon is a fitting recognition of the work which he has done in

building up the business during the past four years. R. R. Scott was elected vice-president, H. F. Keen, secretary and A. H. Goss, treasurer.

E. E. Hudson, as announced in our last issue, has been elected fourth vice-president of Thomas A. Edison, Inc. Mr. Hudson entered the signal supply business in July, 1898, with the Edison Manufacturing Company, as chief clerk in the primary battery sales department. In June, 1902, he left to assume the position of treasurer of the Peerless Fashion Company, in which his family was financially interested, remaining several months until the company changed hands. He then entered the service of the United States Steel Corporation as an accountant in the comptroller's department, remaining there until December, 1903, when he went with the Battery Supplies Company, Newark, N. J., as

E. E. HUDSON.

secretary and treasurer, assuming also position of sales manager in 1905. He returned to the Edison company in 1908, upon the absorption of the Battery Supplies Company, as assistant manager sales, primary battery department, and was appointed sales manager of this department in February, 1909, holding this position until his recent election to a vice-presidency.

RAILWAY SUPPLY EXHIBIT ASSOCIATION.

The Railway Supply Exhibit Association was organized at a meeting held Thursday, November 20, in the club rooms, by the exhibitors in the Railway Supply Permanent Exhibit, Karpen Building, Chicago. A constitution was adopted, and officers elected as follows:

President, A. F. Young, International Harvester Co.
Vice president, J. Will Johnson, Pyle National Headlight Co.
Secy. and Treasurer, W. F. Hebard, The Buda Co.

Other directors elected were, F. D. Fenn, Crane Co.; F. E. Wade, Fairmont Machine Co.; H. P. Teare, Calumet Supply Manufacturing Co.; J. W. Mack, Specialty Device Co.; A. B. Cross, Frost Paint & Mfg. Co.; W. B. Wood, Forest City Paint & Varnish Co.; Henry Fisher, Verona Tool Works; Harold A. Smith, Railway Review.

The objects of the new association as set forth in the constitution are "to promote the interests of its members through mutual co-operation and friendly intercourse; to establish and maintain cordial and profitable relations between members of the association and the delegates of American Railways; and to such ends, to organize conventions, and to establish and care for exhibits of members at these and other conventions."

Membership is open to corporations, firms and individuals engaged in the manufacture and sale of railway material, engineers or contractors engaged in railway construction, publishers of the technical press, and others interested in railways. A complimentary dinner was served to the members of the new association by the management of the Karpen building. The next meeting will be held in the assembly room, 12th floor of the Karpen building, the first week in December.

OBITUARY.

Edward L. Adreon, Jr., president of the Adreon Mfg. Co., St. Louis, died at his home, 5706 Cabanne avenue, St. Louis, on November 18, after an illness of four months. Mr. Adreon was born October 14, 1872, and received his education at St. Louis High School and the Manual Training School of Washington

E. L. ADREON, JR.

University. He entered business life as assistant to the superintendent of the Missouri Electric Light Co., afterwards becoming St. Louis representative of the Sargent Co. and the American Brake Shoe & Foundry Co. In 1903 he, with others, formed the Adreon Mfg. Co., dealers in and manufacturers of railway supplies, and was president of that firm from 1903 until his death. He was also vice-president of the Acme Pipe Clamp Co. Mr. Adreon developed and patented several improvements in devices for locomotive and car equipment. His wife and three children survive him as do also his father, E. L. Adreon, Sr., vice-president of the American Brake Co., and his brother, Robert E. Adreon, general manager of the American Brake Co.

The Chicago Burlington & Quincy has signed a contract for the purchase of a 600 barrel daily minimum production for the operation of its locomotives on its Wyoming lines, the Black Hills division and the Colorado & Southern line between Cheyenne and Orin Junction. The Colorado & Southern is owned by the Burlington. The Chicago & North Western already is using upwards of 3,000 barrels of fuel oil from the Midwest and Franco companies daily.

POSITION WANTED—Chief draftsman at present employed desires to make a change. Has had ten years experience in practical shop and drafting work, as well as special instruction in technical courses. Would prefer to be located east of the Mississippi and would consider position either as chief draftsman or motive power inspector. Address chief draftsman, c/o Railway Master Mechanic, 431 So. Dearborn St., Chicago.

Recent Railway Mechanical Patents

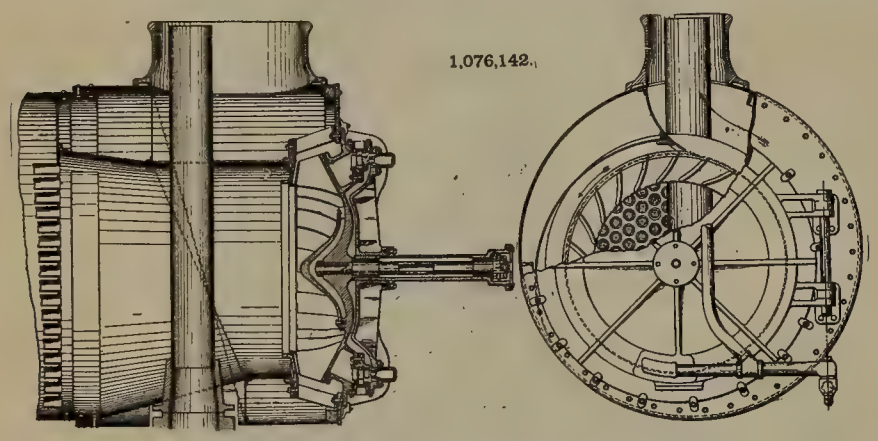
DRAFT APPLIANCE FOR LOCOMOTIVES.

1,076,142—Carl J. Mellin, Schenectady, N. Y.

The object of this invention is to provide an appliance of simple and inexpensive construction, and ready applicability in locomotive engines of the various present standard constructions, whereby the draft necessary to support combustion under service conditions may be induced more economically than by means heretofore ordinarily employed, and the degree of draft induced may be, at all times, under the regulation and control of the engineer.

A casing, of approximately frusto conical form, is connected to the front flue sheet of the boiler, said casing surrounding the set of boiler tubes, and serving to convey the products of combustion to the opening of an annular fan intake plate, which is located a short distance behind the smoke box front.

A centrifugal fan is located in the forward portion of the firebox and is secured on a shaft which is journaled in a bearing on the smoke box door. The fan shown in the illustration is driven by a steam turbine. Steam is admitted to the turbine through nozzles, leading from nozzle boxes, connected to the smoke box, one, two, or more of which nozzle boxes may be used, as desired, the steam being supplied to the nozzle boxes through pipes, which are connected by a swivel joint with a pipe, leading from the steam space of the boiler, and controlled by a valve in the cab of the locomotive by which the speed of



the turbine, and consequently the degree of draft upon the fire, may be regulated in accordance with the requirements of service. The swivel joint of the steam supply pipes is located in line axially with the hinge pin of the smoke box door, so that the door may be opened and closed, as may, from time to time, be required, without disconnecting the pipes. The exhaust steam from the turbine is discharged into a spiral passage leading to the stack, through the spaces between small radial blades, on the rotor of the fan, adjoining the periphery thereof.

The exhaust steam from the cylinders of the locomotive is discharged into the stack through an exhaust pipe, which is open or unrestricted in diameter.

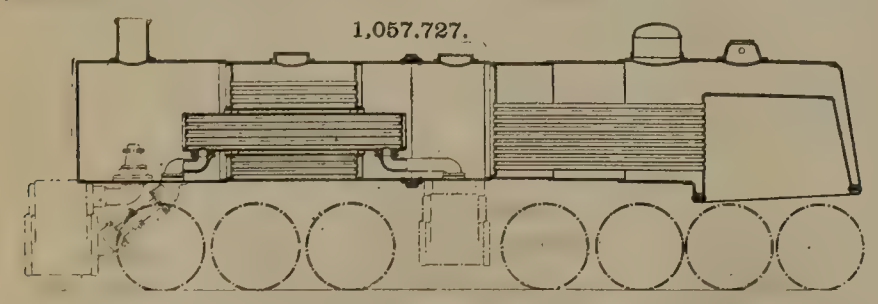
The present universally applied method of inducing draft in locomotive boilers, i. e., by the use of a restricted exhaust pipe from the cylinders, which produces a blast through the stack, involves the well recognized and substantial objection of causing a back pressure upon the pistons which results in a material reduction of power. This is particularly serious in compound locomotives, by reason of the large area of the low pressure piston or pistons. Further, the draft induced by the exhaust blast is not, under all circumstances, proportionate to the demands upon the fire, being, at times, insufficient to generate the required volume of steam, and, at other times, in excess of the requirements of service. These objections are overcome by this invention, the exhaust discharge being unrestricted, and the action of the fan upon the fire being regulated by the engineer in direct proportion to the conditions of operation of the locomotive. The even and comparatively low draft induced by the fan, and the action of the fan blades upon particles of unconsumed fuel that may be drawn through the tubes, will also tend to prevent the projection of sparks and cinders from the stack.

REHEATER FOR LOCOMOTIVES.

1,057,727—Grafton Greenough, Philadelphia, Pa., Assignor, by Mesne Assignments, to Locomotive Superheater Company.

This invention is particularly adapted for use in compound locomotives where the high pressure cylinder is located at some distance from the low pressure cylinder. The main object of the invention is to provide a re-heater for the steam as it passes from the high pressure cylinders to the low pressure cylinders. A further object of the invention is to so construct the heater that it can be mounted in the feed water section of the boiler.

The illustration shows a locomotive boiler having a steam section and feed water section separated by an intervening combustion chamber.



The casing of the re-heater extends beyond the tube sheets of the feed water heater a sufficient distance to allow the pipes to be coupled to the re-heater outside of the feed water heater. The re-heater has headers and extending from one header to the other within the heater is a series of flue tubes. The flue tubes are open at the rear end to the intermediate combustion chamber and at the forward end to the smoke box.

By the above construction it will be seen that the steam has a free flow through the re-heater from the high pressure cylinder to the low pressure cylinder, and the products of combustion will readily pass through the tubes and through the space between the re-heater and the casing, as well as through the tubes of the feed water heater. When repairs are necessary the re-heater can be uncoupled and removed from the boiler and replaced.

GENERAL NEWS.

The divisional organization which has heretofore prevailed on the Cleveland, Cincinnati, Chicago & St. Louis has been discontinued and a departmental organization substituted. The superintendents have been relieved from the duty of supervision of engineering department matters on their respective divisions. In the engineering department, the chief engineer now has charge of all construction and standards, of all matters in connection with contractual relations with individuals and corporations and all work heretofore handled by the engineering department except maintenance of way and structures. A chief engineer maintenance of way has charge of all matters pertaining to maintenance only, reporting direct to the general manager. Engineers maintenance of way report to and receive instructions from the chief engineer maintenance of way on all matters pertaining to maintenance and to the chief engineer on all other matters pertaining to the engineering department.

The Lehigh & New England has leased the Panther Creek Railroad, a 32 mile line between Tamaqua and Nesequehoning, Pa., and is operating it. There are nearly a dozen collieries in the Panther Creek valley which mine anthracite. The whole output will now be transported to tidewater over the lines of the Lehigh & New England. Only a year ago the Lehigh & New England built a new line from Slatington to Tamaqua at cost of $3,000,000 in order to afford an entrance to the company into the anthracite coal fields and compete for business there. E. S. Shipman, superintendent of the company at So. Bethlehem, Pa., succeeds John Lydon as president of the newly leased line.

At the annual meeting of the Traffic Club of New York, held recently, officers for the ensuing year were elected as follows: President, R. H. Wallace, general passenger agent, Erie. Vice-presidents: W. J. L. Banham, traffic manager, Otis Elevator Co.; W. W. Hall, general agent of the St. Paul; J. T. Rogers, traffic manager The Edison Companies; W. H. Snell, general agent, passenger department, Canadian Pacific; A. J. Zock, freight agent, Hamburg-American Line. Treasurer, Frank C. Earle, secretary, C. A. Swope, eastern freight agent, Louisville & Nashville.

The Public Belt of New Orleans is preparing to extend its line.

The Quanah, Acme & Pacific is making surveys on a section of 50 miles for the extension from Roaring Springs, Tex., southwest in the direction of El Paso.

The Salt Lake & Alta has completed track laying on its line from Sandy to Wasatch, Utah, a distance of 11 miles.

The San Pedro, Los Angeles & Salt Lake will begin construction soon on a 15-mile branch line.

The Tonopah & Tidewater is asking permission to issue $294,000 in bonds for constructing 17-mile narrow gage line in Inyo county to Biddy McCarty borax mine.

The Utah Railway has work under way by the Utah Construction Company, Ogden, Utah, on a line from Black Hawk, Utah, north to Castle Gate, also from Provo south to Thistle.

The Wabash will not build a line from Hannibal to Moberly, Mo., at the present time.

The Western Maryland reported contemplating extensive improvements to include tunnelling of Blue Ridge Mountains and and double tracking from Baltimore to Connellsville.

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